6-1-2018

Prevalence and determinants of self-medication with antibiotics in Cairo in high and low-income areas

Shaymaa Mohamed Hassan

The American University in Cairo

School of Science and Engineering

Prevalence and Determinants of Self-Medication with Antibiotics in high and low-income areas within Cairo

A Thesis Submitted to

Biotechnology Department

In partial fulfillment of the requirements for the degree of Master of Science

By Shaymaa M. Hassan

Under the Supervision of

Dr. Rania Siam & Dr. Mahmoud Shaltout

ABSTRACT

The American University in Cairo

"Prevalence and Determinants of Self-Medication with Antibiotics in high & low-income areas within Cairo"

Student Name: Shaymaa M. Hassan
Supervisors: Dr. Rania Siam & Dr. Mahmoud Shaltout

Antimicrobial Resistance (AMR) is currently a global threat, and one of the reasons for increasing AMR rates is antibiotics overuse. Antibiotics overuse is not only due to physician prescriptions -although that is also high- but also because of self-medication with antibiotics (SMA). SMA varies across countries and populations depending on multiple factors and among them is the socioeconomic status. Socioeconomic disparities have been linked to SMA rates. In Egypt, namely Cairo, little data is available regarding SMA or surveillance of antibiotic consumption. The aims of this study were to a) estimate and compare the prevalence of SMA in two socioeconomically different areas in Cairo (high and low-income) b) identify determinants associated with SMA and c) Identify the types of antibiotics used the most. Results showed that SMA was four times more prevalent in low-income area compared to the high-income area (p = 0.00). However, total consumption of antibiotics per family, whether by SMA or prescription, was significantly higher (p = 0.037) in the high-income area. Amoxiciillin was found to be the most consumed antibiotic in both areas Maadi (60.7%) and Shagret Mariam 48.2%. The main reason for SMA in both areas was having previous experience with similar symptoms. Other reasons differed between low income areas (cost of physician) and higher income areas (saving time). Income and education were among the factors related to SMA whereas with lower education and low-income area, there was higher rates of SMA. Further research is recommended to understand SMA behavior and its' socioeconomic determinants, in order to address interventions for regulating antibiotic use.

TABLE OF CONTENTS

List of Tables & Figures

List of Appendices

Glossary of Terms

Antimicrobial Resistance – AMR

Low and Middle-income Countries – LMICs

Self-Medication with Antibiotics – SMA

Social Research Center – SRC

European Center for Disease Control - ECDC

Center for Disease Control – CDC

Institutional Review Board – IRB

Literature Review & Introduction

1.1 Global Health Threat and Worldwide Prevalence

An antibiotic is defined as "any class of organic molecule that inhibits or kills microbes by specific interactions with bacterial targets, without any consideration of the source of the particular compound or class" (Davies, 2010). Antibiotics transformed the medical world and saved thousands of lives since their discovery few decades ago (Davies, 2010 & Gould & Bal, 2013).The high rate of antibiotic usage is speeding up the emergence of resistant genes in infectious microbes (Lobanovska & Pilla, 2017). Antibiotic resistant genes are genes that develop the ability to resist and withstand the effect of antibiotics without getting affected (van Hoek et al., 2011) and the mechanism is either by enzymatically inhibiting antibiotics or through other mechanisms (Davies & Davies, 2010). The resistant genes are not new; they have been always around and part of the natural cycle of microbial evolution and adaptability (Spellberg et al., 2008). Microbes develop resistant genes either intrinsically through random mutation or by a selective pressure through the spread of a genetic material (resistant genes) from one bacteria to another (Fletcher, 2015). The problem is the overuse of antibiotics in medical settings (many times as prophylactic) in agricultural, wastewater effluent, and livestock as preventive medicine to have greater improvement in production and lower cost with less and less infections (Suzuki & Hoa, 2012). The spread of antibiotics use in the environment is causing selective pressure for resistant genes to emerge, contrary to intrinsic resistance, which is believed to be far less common in causing the emerging of resistant genes (Tello et al., 2012). Antibiotic / Antimicrobial Resistance (AMR) is the ability of microbes (bacteria, fungi, viruses, and parasites) to resist the effects of drugs – that is, the germs are not killed, and their growth is not stopped, so the drug is not effective anymore causing difficulty to control spread of infections (Centers for Disease Control and Prevention, 2017). Microorganisms that develop AMR are sometimes referred to as "superbugs" (World Health Organization, 2016). "Antibiotics and similar drugs together are called antimicrobial agents - have been used for the last 70 years to treat patients who have infectious diseases" (CDC, 2017). AMR is becoming a global rising health threat in all parts of the world, especially in developing countries, which affects the ability of current medicine to treat common infectious diseases such as pneumonia, tuberculosis, blood poisoning and gonorrhea (Roca et al., 2015) & (WHO, 2016). AMR in the European Union EU, Iceland and Norway is high and increasing causing serious human and economic consequences according to the European Center for Disease Control ECDC (2009) & (Miller-Petrie & Gelband, 2017). Diseases that seemed treatable are becoming difficult to cure, and one of the main driving reasons for AMR is the overuse of antibiotics in high and Low and Middle Income Countries (LMICs) (Gelband et al., 2015). Data from developing countries are not as available as from the EU, and is expected to be even higher due to the higher rates of infections resulting from poor environmental and health service (Molly Miller-Petrie & Gelband, 2017). According to the World Bank, there is a lack of clinical laboratories availability in LMICs such as in East Africa, where research indicates that the challenge of data collection comes from not only proper surveillance systems but also lack of technical capabilities that provide microbial testing (Aboderin & Martinez, 2016).

Multidrug resistance (MDR) is defined as "the insensitivity or resistance of a microorganism(such as bacteria, viruses, fungi and parasites) to the administered antimicrobial drugs (like antibiotics, antivirals, anti-fungal and anti-parasitic) despite earlier sensitivity to it which makes the conventional therapy ineffective leading to more spread of infection (Singh, 2013). In February of 2017, the WHO published a priority list of pathogens with the greatest threat to the human public health, divided into critical, high, and medium threats (WHO, 2017). One of the critically threatening pathogens is carbapenem-resistant Enterobacteriaceae such as *Klebsiella species* and *Escherichia coli (E. coli)* and those bacteria are becoming more and more resistant to the strongest available antibiotics (Lutgring & Limbago, 2016 & CDC, 2013). Carbapenems is a potent broad spectrum class of antibiotics used to treat multi drug resistance pathogens however recently carbapenem-resistant *Enterobacteriaceae* such as *Klebsiella* species are increasing resistant through different mechanisms (ESER, 2017). One of those is production of carbapenemze enzymes to inactivate antibiotics or through intrinsic bacterial mechanism such as forming biofilms as protection layers (Vuotto et al., 2014). Other examples of MDR microbes include; methicillin-resistant *Staphylococcus aureus* (MRSA), *Streptococcus pneumoniae* and *Mycobacterium tuberculosis* (Fair & Tor, 2014) (Spellberg et al., 2008). MRSA is a serious health threat that causes skin, pneumonia, and bloodstream infections and more resistant than *Staphylococcus aureus* (Durai et al., 2010). In 2005, around 94,000 estimated cases of MRSA infections in the Unites States required hospitalization and around 19,000 death cases resulted from the same infection with 85% of all the infections happening in healthcare settings like hospitals and clinics (Klevens et al., 2007). However, some reports described a decline in the rate of infections in the United States due to improved infection prevention and control, but there is a discrepancy because data is different from one population to the other (Kavanagh et al., 2017). Europe also witnessed a decline in hospital acquired MRSA by 2% from 2012 to 2015, however there is an increase in the community acquired MRS (EARS-Net, 2017). *Streptococcus pneumoniae* is a type of bacteria that can cause wide range of respiratory tract infections such as pneumonia and meningitis and bloodstream infections (Adegbola et al., 2014). Resistance of *Streptococcus pneumoniae* started to appear gradually since the 1970s and currently there is the MDR *Streptococcus pneumoniae* which usually is resistant to more than 3 types of antibiotics (Cornick and Bentley, 2012). *Mycobacterium Tuberculosis* which is an airborne infectious disease that causes tuberculosis disease TB is becoming also increasingly resistant. Multidrug-resistant tuberculosis MDR-TB is the TB bacterium that is resistant to at least isoniazid and rifampin, which are the two most potent current TB drugs (Pai et al., 2016).

In high-income countries, there is a high rate of antibiotic usage in hospitals, communities, and agricultural sectors, which are adding selective pressure on microbes to develop resistance (Hughes, 2014). The overuse of antibiotics in medical settings adds a pressure on the microbe to develop resistance over time and become then susceptible to antibiotics (Shallcross & Davies, 2014). In Europe, there is an increase in resistant strain isolates of bacteria showing amitotic resistance or multiple drug resistance (EARS-Net, 2017). There are around 1000 resistance-related beta-lactamases (antibiotic-inactivating enzymes) bacteria that are resistant to beta-lactam class of antibiotics have been identified till now and this class of antibiotics in considered a strong last-option treatment (Laxminarayan et al., 2013) which is a significant number of bacterial species that developed resistance mechanism for only one class of antibiotics. In Europe, about 25,000 patients die annually from infections caused by MDR bacteria (ECDC, 2009). The most common infections in France that caused around 158,000 cases of MDR infections in 2012 were MRSA, *Escherichia coli* and *Klebsiella pneumoniae* (Colomb-Cotinat et al., 2016). In the United States, around 23,000 people die from antibiotic-resistant bacteria and at least 2 million people get serious infections with one or more of the resistant bacteria and these infections usually require hospitalization (CDC, 2013). One example of one type of enteric pathogens is *Clostridium difficile* which infects around 250,000 people annually in the USA and requires hospitalization in addition to 14,000 death cases annually (CDC, 2013).

In LMICs little data is available on AMR and MDR infections because of the lack of control of antibiotic dispersion, regulations and surveillance (Dondorp et al., 2017). For example, in Thailand as a country representing one of the LIMC country, there are around 45,209 acquired MDR infections (both hospital and community-acquired) and of them around 19,122 deaths per year from the 66 million population of Thailand in 2010 (Lim et al., 2016). The number of deaths in Thailand is similar to Europe however, the population of whole countries in Europe is much greater than in Thailand which reflects the relative percentage of MDR infections. In India, one of the most populated developing countries with many health and economic challenges, more than 5 million children under the age of 5 year old get infected with pneumonia or sepsis (Caused by *Streptococcus pneumoniae* and *Haemophilus influenzae type b* respectively) and 215,000 children die out of the 5 million (Ganguly, 2011). In Nepal, MDR *E.coli* isolates were found highly prevalent in hospital settings for multiple antibiotics (Ansari et al., 2015). A 6-year surveillance study in 503 intensive care unit ICUs in LMICs in Latin America, Africa and Asia in which they are all part of the International

Nosocomial Infection Control Consortium (INICC), the data collected from 605,310 patients showed that device-associated infections were higher by around 5 folds in these countries in comparison to the rate in the ICUs in the US where similar device utilization in hospitals is happening (Rosenthal et al., 2014). In Middle East countries, there is variation in economic prosperity, yet most of them lack basic laboratory settings for antibiotic susceptibly testing and surveillance control leading to an under-reporting of MDR infections (Ahmed et al., 2016).

According to pharmaceutical sales, consumption of antibiotics is rising globally, and one example is Carbapenem (Group of antibiotics used to treat MDR bacteria and more expensive than the other antibiotics) which has dramatically increased sales in LMICs such as India, Pakistan and Egypt (Laxminarayan et al., 2013). The World Health Organization WHO is tackling the issue of AMR with high priority, and a plan was endorsed in May 2015 World Health Assembly and recently in the United Nations General Assembly in New York in September 2016, the Heads of State committed to taking a broad, coordinated approach to address the root causes of AMR across multiple sectors (WHO, 2016).

1.2 Prevalence of Antimicrobial Resistance in the Middle East

Antibiotics are prescribed over the counter in many LMICs including the Middle East, where there are higher rates of infections due to poor environmental and health services (Miller-Petrie & Gelband, 2017). AMR is a problem in the Gulf countries (Qatar, Bahrain, Saudi Arabia, Oman and UAE) with the most prevalent organisms being *Escherichia coli,* followed by *Klebsiella pneumoniae* and other pathogens (Balkhy et al., 2016). AMR's prevalence in the Gulf countries is mainly due to availability of the most advanced antibiotics and lack of infectious control systems (Aly & Balkhy, 2012). Shibl et al., (2009) showed that resistant *Streptococcus pneumoniae* infection, in the Arabian Peninsula and Egypt has a high resistance to penicillin which has been increasing over the years from 0% in the 1980s to 20-40% in the late 1990s and reached 50-80% in 2005. In Qatar, cephalosporin resistance against *Streptococcus pneumoniae* has been reported to be 12%

in children under 12 years old (Al-Tawfiq et al., 2010). Regarding enteric bacteria, in Oman, 31% of the community *Escherichia coli* (*E.coli)* (found in outpatients not hospitalized ones) found in urinary tract isolates were resistant to the antibiotic ciprofloxacin which is usually prescribed to treat such infections (Al-Lawati et al., 2000). Similar types of community *E.coli* isolates in Lebanon were 25% resistant to ciprofloxacin however isolates from inpatients (hospitalized ones) showed much more resistance which is around 40-46% (Fadel et al., 2004). In Saudi Arabia, it was 19% resistance found in the outpatients and 49% in the inpatient (Al-Tawfiq, 2006). In Turkey, comparable isolates from the community (outpatients) showed the highest rates of resistance that is 42.1% which are similar to inpatient resistance rates in other countries (Yilmaz et al., 2009).

1.3 SMA in the Middle East

Antibiotics consumption without prescription is very common in the Middle East and the misuse by many patients is believed to be highly prevalent (Al-Tawfiq et al., 2010) & (Khalifeh et al., 2017). Over the counter medicines in general are being widely used in the Eastern Mediterranean countries (pain killers and antibiotics) without prescription, and behaviors of self-medication were also observed in different studies (Khalifeh et al., 2017). Many people in the Middle East believe that antibiotics should be taken to treat fever which is often caused by a viral infection, and antibiotics is the first treatment option people turn to (Aly & Balkhy, 2012). A cross-sectional study in Palestine supporting Aly & Balkhy (2012), showed that 73% of parents choose antibiotics as the treatment for Upper Respiratory Tract Infections (URTIs) for their children and 59% of the parents did not agree that URTIs are mostly caused by a virus (Zyoud et al., 2015). The more serious misuse of antibiotics is taking antibiotics as prophylactic medicine especially pre and post-operative which has been observed in different studies (Al-Tawfiq et al., 2010). The overuse of antibiotics in hospitals and community is one of the factors contributing to AMR (Prestinaci et al., 2015). A In Beirut, 32% of antibiotics were dispensed without medical prescription and that was more common in lower-income areas than higher (Farah et al., 2015). Furthermore, a larger scale retrospective study from Lebanon also, showed significant AMR challenges where data from 16 Lebanese hospitals were analyzed and showed that the prevalence of MRSA in hospitals is 27.6% and Streptococcus pneumoniae had different susceptibilities depending on the antibiotics used where it ranged from 46% to oxacillin, 63% to erythromycin, and reached even 98% to levofloxacin (Chamoun et al., 2016). A surveillance using nasal swabs for healthcare workers and community members in Sudan showed that 20% had *Streptococcus aureus* and 80% of these isolates were MRSA which was more frequent in the healthcare workers (Babiker et al., 2017). In Kuwait, isolates from a five year data collection of *Clostridium difficile* infection (which causes diarrhea) have been collected and tested to assess resistance and showed high resistance against different antibiotics including ampicillin, clindamycin, and levofloxacin (Jamal & Rotimi, 2016). Also in Kuwait, another study of the community-acquired MRSA has shown an increase in a five year study (2011-2015) however the susceptibility to antibiotics varied along the years which indicates the importance of regular surveillance (Udo et al., 2017). A two year cohort study in Kuwait, United Arab Emirates and Saudi Arabia showed that the main cause for neonatal sepsis infections are Coagulase-negative *staphylococci* and *Klebsiella which were* resistant to third-generation antibiotics Cephalosporins (Hammoud et al., 2017). In Algeria, a study showed high prevalence of MDR *Klebsiella pneumoniae* isolates on surfaces at 3 teaching hospitals which were producing b-lactamases enzymes that are resistant to beta-lactam antibiotics (Zenati et al., 2017). An analysis of all published research on AMR in Africa indicated that around 40% of all countries in the continent did not have any data on AMR which presents a gap in proper surveillance and understanding the magnitude of the problem (Tadesse et al., 2017).

1.4 AMR in Egypt

Consumption of antibiotics in Egypt is high in both healthcare settings and within the community as shown by a survey conducted in 18 hospitals in Egypt (Talaat et al., 2014). This study showed high prevalence of antibiotic use in which 2017 treated patients had received a total of 3194 antibiotic drugs (which means 1.6 antibiotics per patient). AMR as a consequence for over-consumption of antibiotics is increasingly appearing in healthcare settings in Egypt whereas a 10-month active surveillance in three hospitals indicated around 600 pathogens isolated from blood cultures of 1,575 patients where 79%

of all *Klebsiella pneumoniae* isolates were β-lactamase-producing and MRSA was present in 60% of all *Staphylococcus aureus* isolates (Saied et al., 2011). Moreover, in a period of three months from October to December 2016, a surveillance of 28 hospitals showed that in this short time, 91 intensive care units (ICU) resulted in 2688 cases of health-care associated infections with *Klebsiella spp* and *Acinetobacter spp* as the two most common infectious pathogens in hospitals in Egypt (Talaat et al., 2016) and Out of the *Klebsiella spp* infections, 92.8% were MDR species. Analyzing the prevalence of resistance of healthcare- and community-associated MRSA in Egypt over a period of 8 years (2005–2013), 631 Staphylococcus aureus isolates were found and 88% of them were MRSA which was more abundant in the healthcare setting (76.6 %) (Abdel-Maksoud et al., 2016). Around 68% out of 100 patients with gastrointestinal complaints in Zagazig, Egypt, had Extended spectrum β-lactamases Enterobacteriaceae which are resistant to beta-lactam antibiotics and the isolates were mainly *E. coli* and *Klebsiella pneumoniae* (Abdallah et al., 2017). The Egyptian ministry of Health put together a strategy for AMR for between 2016 to 2020 to control and regularly provide national surveillance (Wagdy, 2016). The strategy is divided into three programs; first to monitor the Hospital Acquired infection (HAI) and the second is the detection of community acquired infection and the third is surveillance for the veterinary and environmental sectors however there is no much details on the scale of the surveillance (Wagdy, 2016).

1.5 Causes of AMR Worldwide and in Middle East

1.5.1 Over-use of antibiotics

The overuse of antibiotics is the main driving force causing antibiotic resistance whether through human consumption or in commercial agriculture and livestock (Laxminarayan et al., 2013). Antibiotic overuse also causes higher risk of side effects to patients, reinfection and re-admission to hospitals (Llor & Bjerrum, 2014). Bacterial mutation rate is very high and bacteria developed different mechanisms for increasing resistance to antibiotics such as the biofilm structure of bacteria and with high human consumption of antibiotics, bacteria develops resistance relatively very fast (Reardon, 2014). Around 50% of all antibiotics prescribed are not really needed or used effectively to treat infections (CDC,

2013) and the more antibiotics are used, the more opportunities the bacteria get to evolve and develop resistance. Between 2000 and 2010, antibiotics consumption was increased by 35% in around 71 countries worldwide (Van Boeckel et al., 2014). Such a huge amount of antibiotics dispensed into human bodies and the environment creates niches for infectious pathogens to evolve and resistant genes to develop. Most of the serious resistant bacterial infections come from health-care settings where MDR infections are widespread and hard to treat (Health Policy Brief, 2015). In addition to the overuse of antibiotics, sometime patients do not adhere to finishing the course of antibiotics prescribed for them and this is a great risk for AMR and for reinfection to take place (Fernandes et al., 2014). This non-adherence theory is supported by research that indicated that low non-lethal concentrations of antibiotics cause high risk for mutations and even further increasing stability of mutants genes (Andersson & Hughes, 2012).

Overuse of antibiotics is not limited to medical settings, but also in other areas such as livestock and agriculture which consume great amounts of antibiotics worldwide (Levy, 2014). Farming companies/farmers are using antibiotics on prolonged periods for promoting growth and preventing illnesses which eventually makes it the ideal environment for appearance of resistant genes (Levy, 2014). The overuse in the environment spreads out resistant genes and causes high risk for transmission to humans and it has been shown that these evolved resistant genes are found in the stomach of human consuming or in close interaction with livestock (Chang et al., 2015). More recent evidence showed that resistance genes are being transferred from animals to humans based on whole genome sequencing (Harrison et al., 2013). In the United States, human consumption of antibiotics represents only around 20% and the rest is used in agriculture, fish farming and livestock (Health Policy Brief, 2015). In Europe, the use of livestock is not as high as in the USA and some countries are restricting now the use of antibiotics in livestocks. Denmark is one of the few countries taking the lead successfully in limiting antibiotic use in livestock and agriculture (Levy, 2014). Recently, interesting findings revealed that disposed wastewater from hospitals actually are a niche for the emergence of antimicrobial-resistant genes since a lot of antibiotics used in the hospitals (Czekalski, et al., 2014).

1.5.2 Decline in development & research of new antibiotics

Between the 1940 and 1962, 20 new antibiotics were introduced which revolutionized human medicine and saved millions of lives and the use of antibiotics extended beyond the medical field (Coates et al., 2011). Since then most of the newly marketed antibiotics are just analogues of the already discovered ones from the late 1960s and few ones have been developed since (Coates et al., 2011). Antibiotics research and development does not attract pharmaceutical industry for multiple factors, one of them is their short time treatment duration (usually less than two weeks) for total cure. The second reason is that other drugs taken for chronic diseases are usually given for longer duration and accordingly they are more profitable and regularly on demand since patients get these medications over the course of their life time (Spellberg et al., 2007). In addition, it is more affordable to fund research and development of analogues of antibiotics than to develop new compounds of antibiotics (Coates et al., 2011).

1.5.3 Self-medication with Antibiotics SMA (Worldwide & Middle East)

SMA is one of the causes accelerating the AMR problem globally which has serious consequences (Versporten et al., 2014). Numerous studies have been conducted in developed countries to detect the scale of the problem on different population groups, however fewer studies have been carried out in developing countries where the problem is more widespread, and surveillance is not regular or sometimes absent (Okeke et al., 2005). In Europe however, there are more data available that compares different countries' prevalence. There is a significant variation within the European countries whereas, the highest rate of SMA was in France and the lowest rate was in the Netherlands (Goossens et al., 2005). In the United States, antibiotics are being sold without prescription online a lot with the most available antibiotics penicillin which is available by 94.2% of all the online outlets which encourages SMA greatly (Arch et al., 2009).

Some countries in the Middle East studied SMA behaviors and determinants, but not on a large enough scale to understand the complex issue in relation to AMR. However, these available publications together show the need for more research on SMA. Sudan and Jordan had the highest SMA rates followed by Abu Dhabi and Beirut. In Sudan, 73.9% of the studied population (which was around 1293) had used antibiotics or antimalarial without a prescription within one month prior to the study (Awad et al., 2005). In Jordan, 67.1% of patients believe that antibiotics treat common cold and cough, 28.1% misused antibiotics as pain killers, 11.9% of females were not aware of antibiotic safety and usage during pregnancy, 28.5% had antibiotics at home for emergency and 55.6% used them as preventive treatment against potential infections (Shehadeh et al., 2012). In Abu Dhabi, 56% (out of 860) reported the use of antibiotics during the last year and 46% stated that they intentionally use antibiotics as self-medication with no physicians' prescription and the research indicated that the higher level of education, the higher rate of self-medication (Abasaeed et al., 2009). However, the percentage is less in Beirut, where 42% of people purchasing antibiotics are getting them without prescription and 39.7% of them said that the main reason they did not go to a physician was to save time (Mouhieddine et al., 2015). In Kuwait, a similar research was carried out and around 72.8% of participants had taken antibiotics in the last year before the study and 27.5% of them had antibiotics without medical prescription (A. I. Awad & Aboud, 2015). Regarding adherence and finishing the course of treatment, in Kuwait 36% of antibiotic consumers did not adhere to the course of treatment (A. I. Awad & Aboud, 2015). In Riyadh in Saudi Arabia, 78% of pharmacies dispense antibiotics without prescription (Habibzadeh, 2013). Another study in Saudi Arabia indicated that (70.5%) of the pharmacists in Makkah were not aware that dispensing antibiotics without prescription was illegal (Hadi et al., 2016). Another factor contributing to AMR is non-adherence to the course of antibiotics which promotes recurrence of infections, resistant of bacteria and the inability to treat the initial infection (Fernandes et al., 2014). Ocan et al., 2015 indicated that SMA prevalence is high in many different countries and this variance is associated with social determinants of health such as education and socioeconomic level.

1.6 Self-medication with Antibiotics in Egypt

In Alexandria, Sallam et al., 2009 found that 79.9% of the pharmacy visitors reported SMA and the main reason was that patients (pharmacy visitors) perceived their health problem as a minor issue (44.5% thought so) or that they had previous experience from past prescription (Sallam et al., 2009). Another research in Alexandria indicated that 66.9% of pharmacists reported an increase in non-prescribed dispensing of medicines in the last 4 years from 2009 to 2012 (Elhoseeny et al., 2013). In Minya, assessment of physicians and pharmacists prescribing antibiotics for Acute Respiratory Infections (ARI) and the factors behind prescriptions revealed a majority of physicians (64%) and pharmacists (81%) prescribed antibiotic for common cold (Dooling et al., 2014). These results show that there is overprescribing for antibiotics when it is really not needed, and also there is under prescription for infectious diseases like pneumonia that needs antibiotics. These results highlight the necessity and need for awareness of physicians and pharmacists themselves about the safety and use of antibiotics. Hospitals, where MDR infections are more serious, are another area that needs more investigation.

One study in Cairo, conducted over a three-month period of months showed that 1158 antibiotics were dispensed for 884 patients and 23.3% of these antibiotics were dispensed without prescription or pharmacist recommendation (Sabry et al., 2014). Remarkably, the antibiotics that were dispensed on pharmacist recommendations were dispensed by technicians (Sabry et al., 2014). Interestingly, respiratory tract infections were among the leading symptoms/conditions for consuming antibiotics which are viral infections mostly (Sabry et al., 2014). Another cross-sectional study was conducted on 300 medical students from Ain Shams University, and prevalence of SMA among these students was 55% (El Ezz & Ez-Elarab, 2011). More than half of the participating medical students (63.3%) discontinued the self-medication once feeling improvement compared to 14.4% who properly continued the correct course of prescription. Also 60% of students increased the dose of the drug without medical advice (El Ezz & Ez-Elarab, 2011). This prevalence of SMA is high among medical students, and it is critical that they understand and follow the guidelines of antibiotics use. According to the Egyptian law, antibiotics are not legally available without prescription, yet this does not happen (Sabry et al., 2014), which contributes significantly to the prevalence of SMA.

1.7 Determinants of SMA

1.7.1 Education & Place of Residence

Education contributes to improvement and understanding of healthcare issues and it is linked to self-medication, especially with antibiotics and patients who are well educated are expected to have a better understanding of what antibiotics really are and their side effects (Shehadeh et al., 2016). Most evidence shows that with higher level of education and awareness there is less SMA (Moise et al., 2017). In England, public knowledge and behavior towards antibiotic use is associated with level of education whereas, people with lower educational qualifications displayed less knowledge about antibiotics use and AMR (McNulty et al., 2007). In Lithuania, place of residence (urban and rural) was significantly associated with SMA (SMA being higher in urban areas) (Berzanskyte et al., 2006). Another study in Lithuania also showed that and 26.0% of Lithuanian thought antibiotics are effective against viral infections (Pavydė et al., 2015). In Italy, higher education was also associated with more awareness of AMR and knowledge about antibiotics safety (Napolitano et al., 2013). Education level and science background play a role in SMA prevalence in Nigeria where women are taking antibiotics for the treatment of menstrual symptoms where lower levels of education, and non- science background were significantly linked to high prevalence of SMA (Sapkota et al., 2010).

Prevalence of SMA in the Middle East (Iran, Turkey, Saudi Arabia, United Arab Emirates (UAE), Kuwait, Oman, Yemen, Jordan, Syria, Lebanon, Egypt and Israel) is very high (Khalifeh et al., 2017). Most of the countries in the Middle East showed an inverse relationship between SMA and level of education, where lower levels of education meant an increase in prevalence of SMA (Alhomoud et al., 2017). One common factor for SMA among all these countries was access; most patients could get antibiotics from pharmacies without a prescription due to poor regulation (Cheaito et al., 2014). Other factors, such as the belief of some communities in the Middle East that antibiotics accelerate recovery and treat any infection was also observed (Khalifeh et al., 2017 & Alhomoud et al., 2017).

In Kuwait, Syria and Oman, education level is significantly associated with SMA (Awad & Aboud, 2015; Barah & Gonçalves, 2010; & Jose et al., 2013). In Kuwait 47% did not have knowledge on AMR and had poor knowledge regarding use, safety, and resistance of antibiotics (Awad & Aboud, 2015) which is interesting because 87.5% had high level of education (bachelor's degree and higher) and 12.5% only had lower education level (completed secondary school or less). Being male, younger individuals, low and medium income, and lower educational status (high school certificate or less) showed high SMA and little knowledge about antibiotics according to a study done in Kalamoon, Syria (Barah & Gonçalves, 2010). In Beirut, 80.2% of respondents knew that antibiotics are anti-bacterial but 73.5% of them did not know that antibiotics were different than anti-viral (Mouhieddine et al., 2015). Interestingly in Abu Dhabi, Sudan and Alexandria, Egypt, rates of SMA were higher among those with higher level of education (university degree and higher) (Abasaeed et al., 2009; Awad et al., 2005; Sallam et al., 2009). Additionally, 82.4% of pharmacists in Alexandria mentioned that lack of knowledge among patients on the active ingredients of a specific brand is the major reason for the increase in non-prescribed medication use (Elhoseeny et al., 2013). Kandeel et al., 2014, revealed that some of the determinants affecting patients' use of antibiotics for ARI were mainly patient preference in adults and in case of younger patients their caregivers (parents) also preferred antibiotics thinking that they can be used as a prevention for common cold (Kandeel et al., 2014).

1.7.2 Sanitation in low-income countries

Poor hygienic conditions associated with lower socioeconomic class facilitate the transmission of vectors and pathogens which causes long-term illness that further exacerbates poverty by diminishing productivity (Bhutta et al., 2014). In Poland, socioeconomic status, and sanitation increase the risk factors for transmission of *Helicobacter Pylori* (Łaszewicz et al., 2014). The recent Ebola outbreak in West Africa seemed to be associated with lower socioeconomic levels whereas infection emerged and occurred far more frequently in poorer areas within Liberia (Fallah et al., 2015). Sanitation plays a role in recurrence of infections, and consequently increases the antibiotics consumption. Poor sanitation and hygiene, which characterizes what most people under the poverty line in the developing world encounter,, increases the risk of water-borne diseases (Garchitorena et al., 2017). Findings from Alvarez-Uria et al., (2016) shows that sanitation and poor hygiene in developing countries represent great challenges for combating AMR because the spread of resistant organisms can occur easily through poor hygiene and improper sewage systems. Diarrheal infections in Dakahlia were highly related to poor hygienic conditions which correlated significantly with the incidence of diarrhea (El-Gilany & Hammad, 2005). In Dakahlia, antibiotics were the most used medications for diarrheal infections among children, although they were not as effective in treating infections (because of reoccurrence) or symptoms (El-Gilany & Hammad, 2005). In Alexandria, 38% of the health units and centers' staff received training regarding injection safety and sterilization practices and only 42.2% of the staff who dealt with medical waste had access to gloves (Elhoseeny & Mourad, 2014). Prevalence of infection of *Helicobacter Pylori* in Egypt was twice as high in the rural region than in the urban one (Awdalla et al., 2010). These hygiene practices contribute to the AMR crisis in Egypt. In developing countries where access to clean water and hygienic environment is a challenge, there is a high probability of infection transmission.

1.7.3 Socioeconomic Level & Poverty

Poverty has been cited by the WHO as a main factor causing the quick development of AMR (WHO, 2004). A comprehensive study done in 2006 in 19 European countries indicated that prevalence rates for SMA were the highest in Eastern Europe (Romania and Lithuania), followed by southern Europe (Malta, Spain, and Italy) Europe and the lowest rates of SMA were in northern and western (the Netherlands and Sweden) Europe (Grigoryan et al., 2006). These data indicate that the countries' income and the socioeconomic level might be a major determinant for SMA. Another study in five European countries showed high increase of antibiotic prescription for children and adolescents especially in the winter months for mostly viral infections, Italy had the highest rates followed by Germany, the UK, Denmark and the Netherlands (Holstiege et al., 2014). In Lithuania, 61% of people had little knowledge about what antibiotics do and 26% of them identified antibiotics as a therapy effective against viral infections

(Pavydė et al., 2015). However, in Sweden, only 19.1% who agreed that antibiotics cure common colds/ viral infection (André et al., 2010). Sweden is a country with a much high-income than Lithuania (The World Bank, 2017) and this is high and low-income ratio relates directly to the rates of SMA. In Lithuania people from rural areas used 1.79 times more non-prescribed antibiotics than people living in urban areas (Berzanskyte et al., 2006). According to Morgen et al. (2011), the rate of SMA in Central America was 19% compared to just 3% in Nordic countries. These data support the relationship between country's high-income status and the socioeconomic level as a determinant of the SMA rate and misuse of antibiotics.

LMICs have much higher rates of infections than high income countries, whereas the prevalence of health-care-associated infections is 15·5 per 100 patients, twice as high as numbers reported in Europe and the USA (7.1 per 100 patients), furthermore, infections associated with health-care setting in LMIC is 3 times higher than in the USA (Allegranzi et al., 2011). Furthermore, SMA was found to be 44.1% in South America where socioeconomic levels are similar to those in the Middle East where SMA was estimated to be 34.1% (Ramay et al., 2017). Bloom et al., 2015 indicates that poverty is a main factor in making self-medication more common especially in Lower Middle-Income Countries LMICs (which are defined and listed according to the World Bank based on gross national income such as Egypt, Sudan, and Morocco), where a visit to physicians might be unaffordable, and time is saved. In Guatemala City, same determinants (socioeconomic level and saving time) were among the main reasons for SMA (Ramay et al., 2017). A comprehensive assessment done in 45 countries revealed indirect association between country's income and the prevalence of AMR specifically in relation to three resistant pathogens: third generation cephalosporin-resistant *Escherichia coli* and 3rd generation cephalosporin-resistant *Klebsiella sp* and methicillin-resistant *Staphylococcus aureus* (MRSA). Findings show that the higher the country's income, the lower the AMR prevalence for the three pathogens (Alvarez-Uria et al., 2016). People with low and medium income in Kalamoon, Syrian and also in Sudan showed high SMA rates and lower knowledge towards antibiotics (Barah & Gonçalves, 2010) (Awad et al., 2005). Little research exists in Egypt with respect to the relationship between poverty and SMA.

1.7 Antibiotic Usage for Gastrointestinal Infections:

Enterobacterial infections are bacteria that infect the digestive tract such as *Klebsiella* species and *Escherichia coli* (Centers for Disease Control and Prevention, 2016). Rezaie et al., 2010 indicated that the likelihood of patients with irritable bowel syndrome (IBS) who received antibiotics developing clinical symptoms is twice as much as those receiving just a placebo instead. This research indicates that while antibiotics are beneficial in relieving short-term symptoms, they change the enteric bacterial flora, and which might result in emergence of invading infectious and pathogenic species (Rezaie et al., 2010). Research on gastrointestinal infections in relation to antibiotic usage is scarce in Egypt. A household survey of diarrhea was done among 4458 children under 5 years in Dakahlia governorate from June 2002 to May 2003 to determine the prevalence and determinants of diarrheal diseases. Results showed that the frequency of diarrhea in the previous two weeks and last 24 hours since the data collection were 23.6% and 8.7% respectively and 24.3% of children were using rehydration solutions during the diarrheal episode (El-Gilany & Hammad, 2005). The interesting finding of this research was that the diarrhea frequency was significantly high among children from rural areas during the summer season who were 6-24 months, had younger mothers with lower education levels, and who were unemployed (El-Gilany & Hammad, 2005).

1.8 Significance of this Research:

1.8.1 Economic Burden of AMR

Addressing the prevalence of SMA in Egypt and the factors driving SMA such as education, socioeconomic level and sanitation is necessary especially in a growing population of 2 million per year according to the Central Agency for Public

Mobilization and Statistics (CAPMAS) (UN WPP, 2017). According to WHO (2012), lack of surveillance data on AMR contributes to poor understanding of the scale of the problem in the Middle East, as well as absence of large-scale testing for susceptibility of resistance microbes. According to European Center for Disease Control ECDC (2010), four of 26 (15%) LMICs have implemented surveillance systems and provided guidelines for health-care-related infections at the national level. Out of the total 147 developing countries, only 23 countries (16%) have reported having a functional national surveillance system for health-care acquired infections however Egypt is not one of them (WHO, 2010). This lack in epidemiological data makes it hard for the involved stakeholders to view the impacts of AMR and the magnitude of the crisis in the Middle East. This study is also significant in terms of understanding the economic burden on developing countries. In the United States - a developed country- the economic burden from the healthcare-setting infections associated with hospitalization from resistant infections is calculated to be around $20 billion and another $35 billion annual cost estimated as lost productivity and workforce (CDC, 2013) in addition to 8 million hospital days extra (Roberts et al., 2009). The associated cost of treatment for infectious diseases in general in Europe is estimated to be 1.5 billion euros per year for 25,000 patients (ECDC, 2009). The economic burden of AMR and health-setting associated infections is not known in developing countries because of the lack of data (Miller-Petrie & Gelband, 2017). In Europe, around 7 billion Euros is estimated to be the cost of health-care associated infections alone and 37,000 death cases annually (ECDC, 2009). Some numbers of some of the economic burden is available in Mexico whereas, the ICU-related infections cost around US$12,155 per case for bloodstream infections. Moreover, in Argentina, the cost was US$ 4888 and US$ 2255 for catheter-related bloodstream infection and health setting-associated pneumonia respectively (Arabi, 2008 & WHO, 2010). Infections with resistant organisms not only result in greater severity and higher rates of morbidity and mortality, but also increase health care treatment costs and long-range expenses related to research and development of new drugs (Meyer et al., 2011).

1.8.2 Antibiotics in Egypt

This healthcare burden can hit any chance for economic development if the issue is un-tackled. There is an urgent need for surveillance and data collection in the developing countries on a nation-wide scale whereas AMR is expected to be more prevalent. As a developing country, Egypt has several health challenges and a population on the rise (Elgharably et al., 2017). Developing surveillance systems and acquiring data is essential for estimating the burden of the problem. The need to assess the consumption and the risks associated with overuse of antibiotics is accordingly very relevant in a populous country like Egypt in addition to limiting the onset of a public health crisis. Egypt's overuse of antibiotics is on the rise in which consumption of broad spectrum penicillin and Cephalosporins antibiotics has doubled between the period of 2005-2015 in Egypt (Alvarez-Uria et al., 2016). Therefore, it is expected that AMR would also be more prevalent as a result. (ResistanceMap, CDDEP). Healthcare system in Egypt is divided into public and private with the private sector being widespread and fragmented without any monitoring, regulations, or certification of quality (Regional Health System Observatory, 2006). This system has many challenges when assessing the AMR situation on a nationwide scale because the private sector hospitals and clinics are double the number of the public ones and cannot be ignored in the monitoring of AMR or studying the rates of SMA.

1.8.3 Purpose of the Study

Although some studies were conducted in Egypt on the spread of antibiotic misuse and patient knowledge about antibiotic safety, no study investigated if socio-economic factors are associated with SMA behavior. In addition, many of the studies done on SMA were not in Cairo. Most of the large epidemiological studies were done on hospital-acquired infections and AMR prevalence however, less is conducted in terms of community infections or rate of consumption of antimicrobials. There are four studies done in Alexandria, Egypt ; three of them (Elhoseeny et al., 2013 & Sallam et al., 2009 & El-Nimr et al., 2015) evaluated the use of nonprescription medications in general and self-medication but it was not focused on antibiotics. However, a very recent publication estimating the SMA in Alexandria, showed that 64% of the studied population used antibiotics without prescription in the last 12 months (El-Hawy et al., 2017). In Minya, 83% of outpatients at government clinic who had a respiratory tract infection had been prescribed at least one antibiotic and many caregivers (45%) and adult patients (35%) believed that antibiotics can be used to prevent common cold (Kandeel et al., 2014). In Cairo, Sabry et al., (2014) found frequent antibiotics being dispensed from pharmacies without prescription with 61% of the dispensed antibiotics being appropriate for the indicated symptoms. However, there is less data available in Cairo about SMA. **The purpose of this study is to thus:**

1) Estimate the prevalence of SMA in high and low-income areas.

2) Identify the determinants associated with SMA such as poverty/ socioeconomic, education and sanitation.

3) Identify the types of antibiotics used the most by the two-selected population.

Methodology

2.1 Study design

The study was designed as a cross-sectional study to investigate the prevalence of antibiotic consumption and SMA between two different socioeconomic areas in Cairo. A cross-sectional study was selected in order to collect data at a specific point in time and thus be suitable for estimating the prevalence of a disease or a behavior (Setia, 2016) - in this case SMA. This type of study is also suitable for population-based investigations which can be conducted in a time-efficient manner, and is inexpensive (Thelle & Laake, 2015). In a cross-sectional study, the researcher measures the exposure (in this study, the socioeconomic factor) and the outcome (which is SMA) of a disease at the same time, unlike cohort studies and case control which involve participants who have either been exposed or have the outcome, respectively (LaMorte, 2016). Cohort studies selects participants who are similar in everything except one group is exposed to a certain factor and the others are not exposed, for an extended period of time to observe the development of a disease/outcome (Thelle & Laake, 2015). On the other hand, case-control studies investigate certain populations/groups with a disease (outcome) and compare it with others who do not have this outcome in order to identify the risk factors/exposures that caused or were related to the disease/ outcome (LaMorte, 2016). Cross-sectional studies examine both exposure and outcomes at the same time (Setia, 2016), prepare for further causality investigations and mainly estimates the prevalence of a disease/outcome like SMA in this research.

2.2 Questionnaire Selection

After selecting the research question, different research papers examining prevalence of SMA in different settings and communities were reviewed to select an appropriate questionnaire for the study. Researchers were contacted from Lithuania, Jordan, Lebanon, and Egypt to obtain relevant questionnaires for scrutiny. Elhoseeny et al.'s 2013 questionnaire in Alexandria examined pharmacists' behavior and opinion rather than patients and was thus omitted. In Cairo, Sabry et al.'s 2014 survey studied antibiotics dispensed from pharmacies with focusing on the appropriateness/symptoms of the patients more than on SMA. Kandeel et al., 2014's research in Minya, Egypt on patients' attitudes using antibiotics was a qualitative study rather than quantitative. Mouhieddine et al's, 2014 questionnaire was more on the prevalence and knowledge about antibiotics rather than self-medication. Sawair et al.'s, 2009 research questionnaire from Jordan were close-ended,a criterion needed to give clear precise answers especially in this study's comparison of particpants from two districts with different backgrounds and educational levels (See Appendix A). Therefore, Sawair's questionnaire was selected. Sawair's questionnaire was composed of seventeen questions. The first section (six questions) examined demographic information of participants, andthe second section (composed of four questions) inquired about perceived health, chronic diseases, having health insurance including type and coverage, and smoking status. The third section examined antibiotic consumption in the last six months without a physician consultation, symptoms for taking antibiotics, type and source of antibiotics, and reasons for self medicaiton.

2.3 Consultation with El-Zanaty & Associates

After selecting the questionnaire, a consultation was made with El-Zanaty & Associates, a research agency involved in conducting large scale research.. El- Zanaty also is the implementer of the Demographic Health Survey (DHS), a nation-wide representational survey providing data on population and health in Egypt, funded by US Agency for International Development (USAID). Dr. Fatma El Zanaty, director of El Zanaty Associates*i, kindly reviewed and commented on the questionnaire which greatly helped in fine-tuning the questions. Dr. Zanaty explained that some of the questions should be divided into two questions for clarity and precision. Below are the details for the modifications.

2.4 Modifications and Re-Structuring the Questions

The modified questionnaire had 31 questions (See Appendix B), compared to 17 questions from the original study by Sawair et al. (2009). The first part was designed to obtain demographic information of the interviewees such gender, education level (divided into six categories), income (divided into six categories), and marital status (divided into four categories). The second part of the questionnaire had questions about consumption of antibiotics in the last six months by the interviewee or for his/her dependents (children), followed by a question on self-medication and reasons behind this. The questionnaire also included a range of symptoms that triggered patients/interviewees to consume antibiotics, whether through a physician's prescription or self-medication. Antibiotics consumed were also asked about and a list of all trade names were provided for interviewees to select from and to select more than one type if applicable. The trade names of antibiotics were listed in the questionnaire according to their generic category/ active ingredient so an understanding of the most consumed types of antibiotics can be provided.

The difference in the number of questions between the modified questionnaire and the Jordanian one is the addition of subdivision questions that are further investigating the original questions in the Jordanian study in a more simplified way This subdivision and simplification of questions was also recommended by Dr. El Zanaty for accommodating the diversity between the low-and high-income areas with different educational levels and backgrounds. According to Storms et al., (2017), people with limited literacy and low education have difficulties in comprehending vocabulary, sentence structure and the decision process during health questionnaires, therefore minor changes were done to facilitate interpretation and understanding. The following are the details of all the modification and changes in the questionnaire

1. Question 1: The residential area of the participant was added since it was the most important inclusion criteria; the study's participants are divided into low-income and high-income areas. This question was also in Sawair et al., 2009, however it was made the first question in this study.

2. Questions 2, 3 and 4: These three questions were on age, gender, and marital status and all three of them were adopted verbatim from Sawair et al.s 2009 questionnaire.

3. Question 5:A polar question (yes or no answer) about having children, newly incorporated with Dr. El Zanaty to learn if participants' self-medication behavior is correlated to them having children, since antibiotics consumption was to be measured in the family.

4. Question 6: asked about how many children participants had, given participants answered the previous question positively (having children) to understand if also it correlated with SMA.

5. Question 7 and 8: These two questions inquired about level of education and employment status, and remained unchanged from the original questionnaire.

6. Question 9: Examined participants' occuptation as a follow up to uncover occupational differences between the two areas; a newly added item.

7. Question 10: The monthly income of the family was the same as Sawair et al., 2009 questionnaire, however changes to the set of answeres were made in order to reflect salary range in Egypt (CAPMAS, 2015). Salaries ranged from less than 1500 EGP (84 USD) to 12000 EGP (672 USD) and above. (See Appendix B).

8. Question 11 and 12: Examined self-perceived health (good, intermediate and poor) and the presence of any chronic diseases. Originally, they were presented as one question in the Jordanian version, and this question was thusdivided into two sets of questions for simplicity.

9. Question 13 and 14: Inquired about having health insurance, and the percentage of coverage. Sawair et al., 2009 had both questions as a single question, and was divided in this study for simplicity.

10. Question 16: A yes/no question about smoking, adopted as is from the original questionnaire .

11. Question 17, 18, 19 and 20: Investigated the consumption of antibiotics by the participant himself/herself or by his/her children and care receivers (such as eldely mother or father) and if they self-medicated or they consulated a physciain. The original questionnaire combined four questions in one by simply asking if participants took antibiotics in the last six month without consulting with a physician. The reason for dividing this question into four

was to provide clarity on whether study subjects took antibiotics in the last six months with or without a consultaion of a physician. Therefore to simplfy questions for the two populations in Egypt, questions were selected to be simple with a yes or no answer. Moreover, two of this study's objectives were to estimate the prevelance of antibiotic consumption whether by a prescption or through self-medication, and to estimate the prevelance of SMA. Therefore, these four questions first asked if the participant consumed antibiotics in the last six months and if not, then did his/her children or care receivers (family) had any antibiotics in the same period, followed by the age of children or care receivers and finally, asking if they decided to self-medicate themselves or their care recievers with antibiotics (without a physician consultation). Breaking this question down was necessairy to differentiate between consuming antibiotics by a physician or a pharmacist and self-medicating without prescription.

Question 21: Investigated the reasons behind SMA. Seven reasons were presented (adopted from Sawair et al., 2009) and these seven items included :

- Cost of physician
- Because of no health insurance
- Less time consuming than doctor's visit
- Previous experience with similar illness
- Hate visiting doctors
- No doctors nearby or health units
- Others, ________

12. Question 22: Examined who prescribed/advised participants to take antibiotics and unlike in Sawair's questionnaire which asked about the source of antibiotics.

13. Question 23: Investigated the physical symptoms that led participants to use antibiotics (whether through going to the doctor or by self-medicating), a multiple choice list adopted from the original questionnaire without modifications.(See Appendix A).

14. Question 24 and 25: looked at frequency and duration of antibiotics taken compared to recommended guidelines, also in the original questionnaire..

15. Question 26: Anew question added to assess public knowledge of the the effectiveness of antibiotics in treating bacterial and viral infections. This question was developed through consultation with Dr. El Zanaty.

16. Question 27: was adopted from the original questionaire to address if participants ever changed physicians for getting antibiotics prescription.

17. Question 28, 29 and 30: New items that asked participants whether or not they took medications for diarrhea and contispation in the last three months, as well as history of ulcers. These set of questions were designed to estimate the prevalence of gastrointestinal complaints between the low and high-income areas.

18. Question 31:Adopted from the original with some modifications. ,Initially, participants were asked to mention the type of antibiotics they were taking (Pencillin, Amoxicillin, or Metronidazole), so for the diverse range of Egyptian participants, the trade names of each category of antibiotics that are commonly sold in Egypt were listed. This list was gathered from three pharmacies in Cairo for verification (list can be found in the questionnaire). Next to the trade name of the antibiotics is another list of the generic type for analysis. An extra option "Do not know" was added assuming that not all participants in the two areas will know or remember the type/name of antibiotics they took.

2.5 Selection of the Areas

Selection of the two areas was done based on the Geographic Information System and area-based physical deprivation index (APDI) which divides Cairo into 634 districts (each district is defined as a small size area of 0.5 km^2). The APDI is an index developed by Khadr, et al., 2010 to assess the deprivation level of the areas in Cairo, also tackling the challenge of defining a slum area. This APDI index allowed the ranking of all the 634 districts according to three broad socioeconomic levels namely low, medium, and high, with the low referring to the most deprived areas (See Appendix J). The methodology for constructing the APDI was based on a set of criteria that could be measured by remote sensing: informality, high density, irregular morphology, spatial clustering and other land use activities and important landmarks (Khadr et al., 2010). These criteria were selected because they can be measured using remote sensing technology and also they reflected the five criteria developed by the

UN Habitat for the definition of a slum area (concentration of housing units, lack of sanitation, overcrowding, old structures and lack of water access) (UN Habitat, 2008). A contact was made with Dr. Zeinab Khadr, a statistics professor at the Social Research Center (SRC) at AUC, to randomly select two areas (a low and high area) from the index. Dr. Khadr kindly provided two maps (See Appendix F) for low and high areas and each map covers 4 districts (Total size of the four districts is 2 km). The 4-low level districts are Shagret Mariam, El Matarya El Bahria, El Matrya El Qablia, El Matrya El Gharbia 1. The other 4 high level districts are Maadi Al Sarayat El Sharqia 1, Maadi Al Sarayat El Sharqia 2, Maadi Al Sarayat El Sharqia 3, and Maadi Al Sarayat El Sharqia 4. These areas were randomly selected from the databases containing the 634 districts by Dr. Zeinab Khadr using Excel. The sample size selected for each area (high and the low) was 400, so a total of 800 individuals was the target for the study have been randomly interviewed.

2.6 Consultation with the Social Research Center (SRC) at AUC

Dr. Khadr and Mr. Mohamed Hassan, from the SRC at AUC kindly provided two field researchers (Mahmoud Radwan and Fayrouz who work as part-time data collectors with AUC's SRC) to help with data collection and interviews of the targeted number (800 participants). The researchers were informed and trained regarding the questionnaire and the research objectives of the study. The first day of field work involved monitoring and follow up with the field researchers on understanding the questionnaire and providing feedback on their work such as further explaining the goal of the research to participants and informing participants about the consent form. Following training day, pre-test was conducted with twenty participants.

2.7 IRB approval & Pre-assessment

Before submitting the questionnaire to the Institutional Review Board (IRB) at AUC for approval, the National Institute of Health NIH's Web-based training course "Protecting Human Research Participants" was completed as a requirement for conducting a questionnaire-based study with human subjects. The questionnaire was then submitted to the IRB committee at AUC along with the consent form in Arabic. Obtaining IRB approval lasted around a month of review and editing. Following the IRB approval, a pre-assessment was made prior to data collection, to assess validity and adjust the questions and the language accordingly with randomly selected participants. The pre-test was done for twenty interviewees in one day from 12pm to 4 pm in a randomly selected pharmacy in Maadi, and edits in the language of the questionnaire and their order were made accordingly then these changes were communicated with the field researchers. Based on this pre-test, some participants were not sure of their health insurance coverage and some had less than 50% (question 15 - What is the type of health insurance coverage do you had?) so two options were added: "Do not know" & "less than 50%". In question 23, when asked about physical symptoms, some participants added constipation, eye problems, nausea and anal fissure, so these symptoms were also added to the multiple-choice list. The residency question "Where do you live?" was previously number 10 on the questionnaire but it was moved to be question number one since it was one of the criteria for selecting participates (which is based on their residency in either high or low-income areas).Selection of participants (including criteria) was based on their area of residency whether the low or the high-income area so if participants were not from the areas selected, they would be excluded. As a final step, all questions and answers were coded with numbers for the quantitative analysis on SPSS 21.0.

2.8 Selection of Pharmacies

All pharmacies selected were non-chain pharmacies to ensure the consistency of the methodology in both locations, since Shagret Mariam did not have any chain pharmacies. Selected pharmacies were all locally owned. The methodology of selection was based on randomly walking and checking the existing pharmacies located within the selected areas on the map, then visiting the pharmacies and asking their permissions for conducting the study with the non-chain as the main criterion for inclusion. Selection of the pharmacies was based also on the approval of the owners for conducting the study. A total of seven pharmacies were visited in Maadi (Dr. Mariam pharmacy, Dr. Mai pharmacy, Degla pharmacy, Ahmed Sameh pharmacy, El Yamani pharmacy, El Mashreq pharmacy, and New Maadi pharmacy). The streets in Maadi where the selected pharmacies were located on

Lasalki Street, Street 257, Street 205, and Street 78. In Shagret Mariam, the eight pharmacies visited were (Shagret Mariam pharmacy, El Shefaa El Haditha pharmacy, El Sanabel pharmacy, Dr. Hisham's pharmacy, Dr. Philip's pharmacy, Dr. Said pharmacy, Dr. El Nemr pharmacy, and El Noor pharmacy) and all of them were spread out on seven streets within the selected map. The streets in Shagret Mariam were; El Matarawy Street, Shagret Mariam Street, Menyet Matar Street, Fadel Street, El Balsam Street, El Obour Street, and Badr Street. The research were explained to the pharmacy owners, and approval for conducting the questionnaire to visitors within their premises was obtained. Interviews were then conducted simultaneously in both the low and high areas between 12 pm till 6-7 pm in the evening.

Area 1 _ Eastern Maadi Sarayat

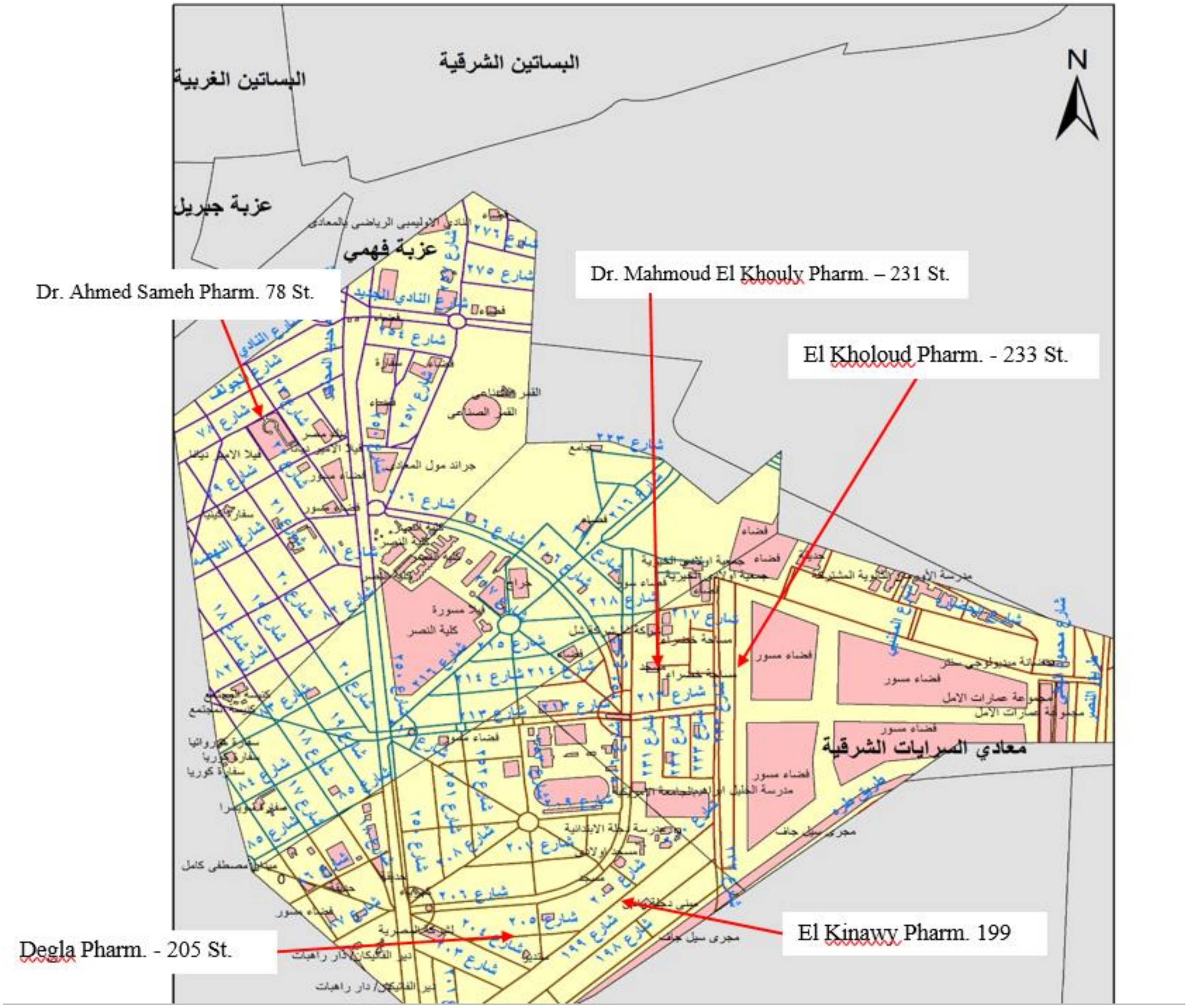


Figure 1 Map showing the 2-km of the selected area of Maadi which represents the high-income area. The map shows 5 pharmacies located in 5 streets. The 1st pharmacy is called Dr. Ahmed Sameh pharmacy located at Street 78. The 2nd one is called Dr. Mahmoud El Khouly pharmacy on Street 231. The 3rd one is El Kholoud pharmacy located on Street 233. The 4th pharmacy is El Kinawy pharmacy on Street 199 and the 5th pharmacy is called Degla pharmacy on Street 205.

Area 2 _ Shagret Mariam

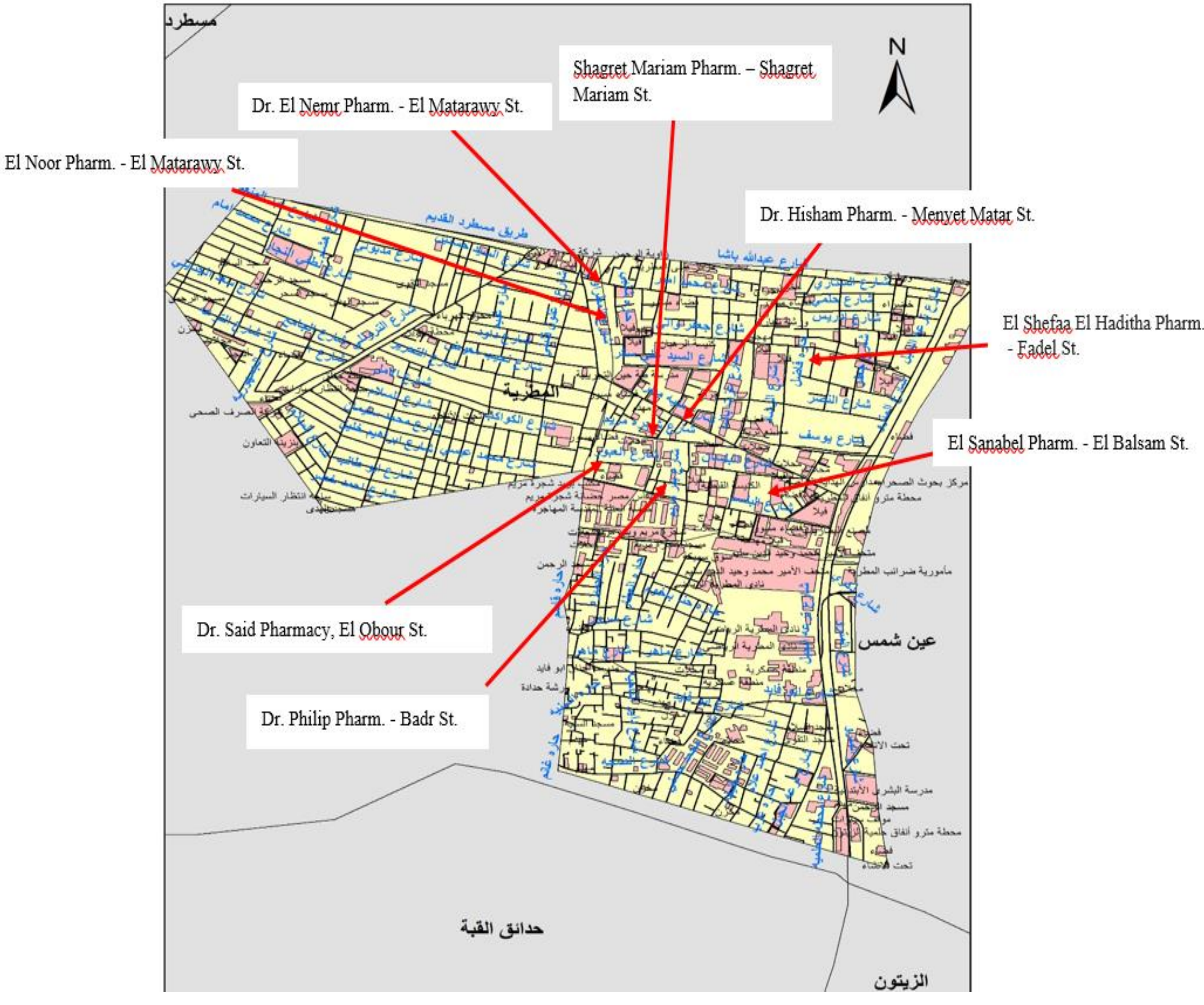


Figure 2 Map showing the 2-km selected area of Shagret Mariam which represents the low-income area. The map shows 7 streets and 8 pharmacies. El Matarawy Street has two pharmacies (Dr. El Nemr pharmacy and El Noor pharmacy). In Shagret Mariam Street, the pharmacy is called Shagret Mariam. The 4th one is Dr. Hisham pharmacy located in Menyet Matar Street. In Fadel Street, the 5th pharmacy is called El Shefaa El Haditha. The 6th pharmacy is El Sanabel pharmacy in El Balsam Street. The 7th pharmacy is Dr. Said pharmacy and located in El Obour Street and the 8th pharmacy is Dr. Philip pharmacy in Badr Street.

2.9 Data Collection

The total sample was 802 individuals with a total margin of error of 3.46% and 95% confidence level. Data collection took eleven days with an average of 40 to 50 interviews per day in each location. Interviewees were customers who were asked to participate upon leaving the above-mentioned pharmacies. Questionnaires were numbered for each location and the response rate was calculated. Data was collected from September 13th to24th, 2017. The questions were asked orally to interviewees and the consent form was explained verbally and the answered were also collected verbally. The reason the interviews were done verbally was because participants had different educational backgrounds in the low and high-income areas and it was expected that not everyone can read and write. Additionally, health literacy varies from one person to another and with lower education too (Storms et al., 2017). Field researchers did obtain the consent verbally and wrote it down followed by the writing down the answers that were asked also verbally to participants. Field researchers were trained to be consistent in wording the questions to avoid any misunderstanding or bias.

2.10 Data Entry and Validation

A total of 402 questionnaires were completed in Maadi, and another 400 in Shagret Mariam area. Data were entered manually on an Excel sheet. All questions and answers were coded with numbers for quantitative analysis on SPSS 21.0. Micro-editing and validation of the data has been made. Micro-editing involved checking any missing data, any errors, and the consistency of data to each individual questionnaire. Data was validated and transformed from an excel file to an SPSS 21.0 file. Data validation was done by reviewing the excel sheets for errors and missing fields. Later, when it was transferred to SPSS 21.0, another check for error character was made by manual scanning then by testing some basic descriptive analysis. Statistical edits also on SPSS 21.0 were done through identifying missing or non-applicable fields and correcting invalid characters.

2.11 Data Analysis – Descriptive analysis

After data entry and validation, basic descriptive analysis was done to highlight the sample characteristics such as percentage and frequency of male and female participants, marital status, educational levels, income of the family, and employment status. Frequencies were generated under descriptive statistics in SPSS 21.0.

2.12 Recoding Variables

A new variable was created to estimate the total antibiotic consumption per family because in the questionnaire there were two questions/variables asking about antibiotic consumption. So, these two variables (antibiotics consumed in the last six months, and antibiotics consumed for children/care receivers were combined into a new variable called "Total consumption of antibiotics". The purpose of combining these two variables was to account for not only the consumption of the questionnaire-taker but also if he/she has given antibiotics to someone they provide care for in the household. After running descriptive analyses for the data, some variables such as education, employment status and level of income were recoded into different new variables. Education had six values (Graduate, University degree, High school, Preparatory school, Primary school, and no formal education) and the statistics showed that majority of the sample in both areas Maadi and Shagret Mariam fell in the 'University degree' or 'high school degree' categories. The six categories of education were thus shortened to three values only (No education, High school degree, and University or higher), also useful for analyses such as Chi-Square. Employment status was also divided into three values instead of five, (Working, Retired or unemployment or student, and housewife) based on the original questionnaire. Level of income consisted of seven intervals, however most of the Maadi sample fell in the highest four intervals (6000-8000, 8000-10000, 10000 – 12000, and More than 12,000) and the majority of the Shagret Mariam sample were in the lowest intervals (Less than 1500, 1500-4000, and 4000-6000). Therefore, the seven intervals were recoded into main categories (low income and high income).

2.13 Significance & Correlation

T-test of percentage was performed to assess differences between the two areas for significance using SPSS 21.0. Variables examined included

1. Status of self-report health
2. Having a chronic illness
3. Having children
4. Having health insurance
5. Prevalence of smoking
6. Prevalence of antibiotic consumption in adults
7. Prevalence of antibiotic consumption in children/care givers
8. Prevalence of total consumption of antibiotics per family
9. Prevalence of SMA
10. Knowledge about antibiotics
11. Frequency of the dose of antibiotics
12. Duration of the antibiotics
13. Going to another physician for antibiotics

Testing significance between the two areas also regarding the following variables have been conducted using Chi-square

1. Residency and education
2. Residency and employment
3. Residency and income

Testing variables (nominal or categorical) for significant correlations was done using Chi-square test of independence. Variable pairings included:

1. SMA & health insurance

2. SMA & employment status
3. SMA and gender
4. SMA & marital status
5. SMA & income
6. SMA & residency (socioeconomic level)
7. SMA & education

2.15 Logistical Regression

To understand the factors causing and contributing to the prevalence of SMA, logistical regression was done on SPSS 21.0. Multiple variables were put into the test to generate more than one regression model to understand the effect and relationship between the different variables.

Results

3.1 Demographic Background

Table 1 below provides a comparative descriptive analysis for the two samples providing some demographic information. A total of 802 questionnaires were completed. The total response rate was 66% (n = 609) in Maadi where 609 people were approached to participate in the questionnaire and only 402 agreed. In Shagret Mariam the response rate was 82% (n = 488) where 488 were approached and 400 agreed to participate. Women made up the majority of respondents, 61.2% *(n =246) in Maadi and 65% (n =260) in Shagret Mariam. In Maadi, the average age of respondents was 42 years old and in Shagret Mariam, average age was 38 years old. Moreover, 81% (n = 325) of respondents in Maadi were married, compared to 65% (n = 261) in Shagret Mariam. In Maadi, 82% (n = 331) had children, while 66% (n = 264) in Shagret Mariam had children, respectively which was found to be significantly different between the two areas (p = 0.000) using t-test of percentage.

3.2 Education and Income

Educational level varied significantly between the two locations (p = 0.000); in Maadi 74% (n = 298) had a university education, compared to 31.5% (n = 126) in Shagret Mariam. The majority of participants from Shagret Mariam had a high school degree 48.5% (n = 194), followed by a university degree 31.5% (n = 126), while 15.5% (n = 62) had a preparatory school degree. In Shagret Mariam, 4.6% (n = 9) of respondents had no education (or primary) compared to none in Maadi. With respect to employment, there was also a significant different in the employment levels between the two areas (p = 0.000), 51.5% (n = 207) of Maadi residents were employed compared to 45.8% (n = 183) in Shagret Mariam. Additionally, 1.7% (n = 7) of Maadi residents and 10% (n = 40) of Shagret Mariam residents were unemployed. Additionally, 33.8% (n = 136) of Maadi were housewives compared to 38% (n = 151) in Shagret Mariam. In Shagret Mariam, the most reported salary range was between 1500-4000 EGP for 61% of the sample (n = 243) and none from Maadi had this salary range. The second most reported salary range in Shagret Mariam was between 4000-6000 EGP where 33% (n = 130) had this salary range compared to 1% (n = 4) in Maadi. On the other hand, the most common salary range in Maadi was 10,000-12,000 EGP representing 41% (n = 165) and none had this salary range in Shagret Mariam. The second most reported salary range in Maadi was more than 12,000 EGP representing 37.3% (n = 150) compared to none in Shagret Mariam. Also, 16.7% (n = 67) of Maadi residents earned between 8000 -10,000 EGP compared to none in Shagret Mariam. Overall, the salaries varied significantly between the two locations (p = 0.000); the salary bracket of 1500 – 6000 EGP represented more than 90% of salaries in Shagret Mariam. On the other hand, in Maadi the salary bracket of 8000-more than 12,000 EGP represented more than 90% of the sample.

3.3 Health status & Insurance

There was a significant different in the self-reported health between Maadi and Shagret Mariam (p = 0.047), whereas 88.6% (n = 356) of Maadi respondents believed their health was good compared to 92.5% (n = 370) in Shagret Mariam and 11.2% (n = 45) in Maadi thought it was intermediate (not too good and not too bad) compared to 7.5% (n = 30) in Shagret Mariam. In Maadi, 13.4% (n = 54) said they had a chronic illness compared to 7.5% (n = 30) in Shagret Mariam which was also significantly different in the two areas (p = 0.006). The most common chronic disease in both areas was high blood pressure, present in 66% (n = 37) of Maadi residents and 77.4% (n = 24) of Shagret Mariam residents. Diabetes is the second most common chronic disease, reported by 57.1% (n = 32) of Maadi residents and 45.2% (n = 14) of Shagret Mariam residents. Heart disease was prevalent in 22% (n = 7) of Shagret Mariam residents while only 7.1% (n = 4) of Maadi residents. Additionally, 3.6% (n = 2) of Maadi residents had high levels of cholesterol compared to none in Shagret Mariam.

Having health insurance was reported by 51.2% (n = 206) of Maadi residents and by 12.5% (n = 50) of Shagret Mariam reflecting a significant difference between the two areas (p = 0.000). A closer investigation of health insurance revealed that 41.5% (n = 86) of Maadi respondents with health insurance had 80-90% coverage, compared to 16% (n = 8) in Shagret Mariam. Also, 25.1% (n = 52) of Maadi respondents had a 50-70% coverage had this coverage compared to 54% (n = 27) in Shagret Mariam. With respect to the 100% coverage, 24.6% (n = 51) of Maadi respondents had it and 12% (n = 6) only in Shagret Mariam. In Shagret Mariam 18% (n = 9) had health insurance coverage below 50% compared to 7.2% (n = 15) in Maadi. Regarding smoking, 34.3% (n = 138) of Maadi are smokers compared to 23% (n = 92) in Shagret Mariam and 2% (n = 8) in Maadi are ex-smokers compared to 0.8% (n = 3) in Shagret Mariam. From these health insurance data, Maadi respondents who had a health insurance 51.2 % (n = 206) were almost double those who had insurance in Shagret Mariam 12.5% (n = 50). In Maadi, the most commonly reported health insurance coverage was the 90-80% coverage plan. In Shagret Mariam, the common coverage plan for those who have health insurance was the one with 50-70% coverage.

Table 1 Descriptive analysis of the sample in the two selected areas

		Maadi (1)	Shagret Mariam (2)	p-value
Variable		402	400	
Average age (years)		42.33	37.52	
Gender	Males	156 (38.8%)	140 (35 %)	
	Females	246 (61.2%)	260 (65 %)	
Marital status	Single	61 (15.2 %)	115 (28.8 %)	
	Married	325 (80.8 %)	261 (65.3 %)	
	Divorced	3 (0.7 %)	14 (3.5 %)	
	Widow	13 (3.2 %)	10 (2.5 %)	
Having children	Yes	331 (82.3 %)	264 (66%)	0.000***
Education Level	Graduate	24 (6%)	0.0	0.000***
	University	298 (74.1 %)	126 (31.5 %)	
	High school	76 (18.9 %)	194 (48.5 %)	
	Prep. School	4 (1%)	62 (15.5 %)	
	Primary	0.0	9 (2.3 %)	
	No education	0.0	9 (2.3 %)	
Employment Status	Working	207 (51.5%)	183 (45.8%)	0.000***
	Retired	17 (4.2%)	3 (0.8%)	
	Unemployed	7 (1.7%)	40 (10%)	
	Housewife	136 (33.8%)	151 (37.8%)	
	Student	35 (8.7%)	23 (5.8%)	
Income (EGP)	Less than 1500	0.0	11 (2.8 %)	0.000***
	1500- 4000	0.0	243 (61.2%)	
	4000-6000	4 (1%)	130 (32.7 %)	
	6000-8000	16 (4%)	13 (3.3 %)	
	8000 – 10,000	67 (16.7%)	0.0	

	10,000 – 12,000	165 (41 %)	0.0	
	More than 12,000	150 (37.3%)	0.0	
Self-reported Health	Good	356 (88.6 %)	370 (92.5 %)	0.047*
	Intermediate/poor	46 (11.4 %)	30 (7.5 %)	
Having Chronic Illness	Yes	54 (13.4 %)	30 (7.5 %)	0.006**
Chronic Illness	Diabetes	32 (57.1%)	14 (45.2%)	
	Heart problems	4 (7.1%)	7 (22.6%)	
	High blood pressure	37 (66.1%)	24 (77.4%)	
	High cholesterol	2 (3.6 %)	0.0	
	Stomach issues	1 (1.8%)	0.0	
	Thyroid	0.0	2 (6.5%)	
Health Insurance	Yes	206 (51.2 %)	50 (12.5 %)	0.000***
Insurance Coverage	100% covered	51 (24.6%)	6 (12%)	
	90 -80 %	86 (41.5%)	8 (16 %)	
	70 -50 %	52 (25.1%)	27 (54 %)	
	Less than 50 %	15 (7.2 %)	9 (18 %)	
	Do not know	3 (1.4%)	0.0	
Smoking	Smoker	138 (34.3 %)	92 (23 %)	0.000***
	Non-smoker/ Ex-smoker	266 (65.7 %)	308 (77.1 %)	

*p<0.05 **p<0.01 ***p<0.0001

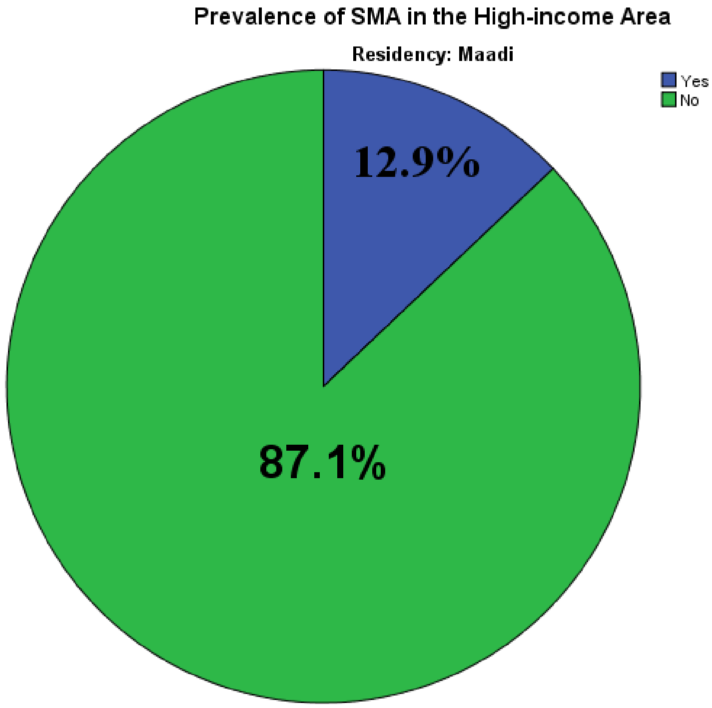
3.4 Prevalence of antibiotic use and SMA

In Table 2, 24.1% (n = 97) of participants in Maadi consumed at least one antibiotic in the last six months and 67.2% (n = 205) of the participants' children and family members consumed antibiotics in the last six months as well. In Shagret Mariam, 18% (n = 72) of the study participants took antibiotics in the last six months and 61.6% (n = 202) of their children and family members they care for, took also antibiotics in the last six months. The prevalence of total consumption of antibiotics per family in Maadi and Shagret Mariam were 75.1% (n = 302) and 68.5 % (n = 274), respectively. Regarding self-medication in the high-income area as demonstrated in Graph 1, 12.9% (n = 39) did SMA in the last six months compared to 47.4% (n = 130) in the low-income area who reported that they did SMA.

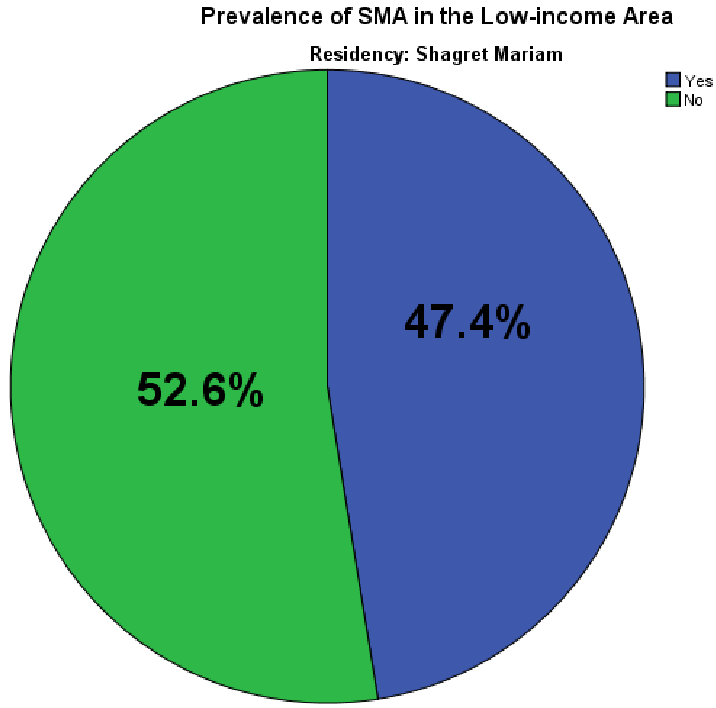
Table 2 Consumption of Antibiotics and Prevalence of SMA Practice in the Two Selected Areas

		Maadi (1)	Shagret Mariam (2)	p-value
Variable		402 (%)	400 (%)	
Antibiotics consumed in last 6 months	Yes	97 (24.1 %)	72 (18%)	0.033*
Antibiotics consumed in last 6 months (children/family)	Yes	205 (67.2%)	202 (61.6%)	0.140
Total consumption of antibiotics (Per family)		302 (75.1 %)	274 (68.5 %)	0.037*
Self-medication prevalence	Yes	39 (12.9%)	130 (47.4%)	0.000***

*p<0.05 **p<0.01 ***p<0.0001



Graph 1 Pie Chart shows the rate of SMA in the high-income area of Maadi where as 12.9% of the population practiced SMA in the last 6 months compared to 87.1% who did not.



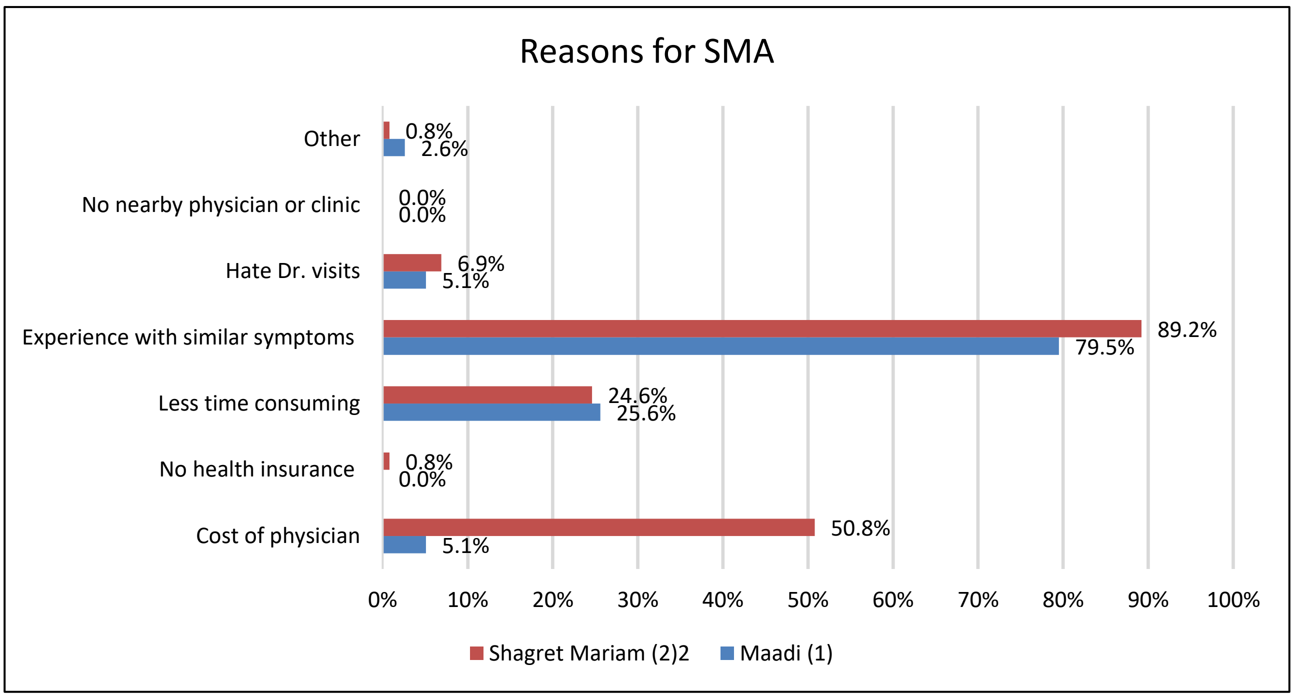
Graph 2 Pie Chart shows the rate of SMA in the low-income area of Shagret Mariam with 47.4% of the population practicing SMA in the last 6 months compared to 52.6% who did not.

3.5 Reasons for SMA

As illustrated in Graph 3 and in Table 3 (below), the main reported reason for SMA in both Maadi and Shagret Mariam was previous experience with similar symptoms, accounting for 79.5% (n = 31) in Maadi and 89.2% of respondents (n = 116) in Shagret Mariam. Responses differed with respect to the subsequent most popular reasons for SMAs between the two residential areas. In Maadi,SMAs were less time-consuming than physician visits, accounting for 25.6% (n = 10), followed by the cost of physician and hating to visit the doctor both accounted for 5.1% (n = 2). In Shagret Mariam, cost of physician visits accounted for 50.8% (n = 66), while another 24.6% (n = 32) of participants practiced SMA to save time. In Shagret Mariam, hating to visit the doctor accounted for 6.9% (n = 9) of responses.

Table 3 – Reasons for SMA in respondents in Maadi and Shagret Mariam

Reasons for SMA	Maadi (1)	Shagret Mariam (2)
	402 (%)	400 (%)
Cost of physician	2 (5.1%)	66 (50.8%)
No health insurance	0.0	1 (0.8%)
Less time consuming	10 (25.6%)	32 (24.6%)
Experience with similar symptoms	31 (79.5%)	116 (89.2%)
Hate Dr. visits	2 (5.1%)	9 (6.9%)
No nearby physician or Clinic	0.0	0.0
Other	1 (2.6%)	1 (0.8%)



Graph 1 shows the reasons for SMA in both Maadi (colored blue) and in Shagret Mariam (colored red) and as the graph is indicating, the main reason for SMA was having previous experience with the symptoms in both areas; Maadi (79.5%) and Shagret Mariam (89.2%). Cost of physician accounted for the second main reason for SMA in Shagret Mariam with 50.8% however in Maadi, the second main reason for SMA was that SMA was less time consuming. Cost of physician and hating to visit the doctor were two reasons for residents of Maadi to SMA accounting for 5.1%. Yet in Shagret Mariam, saving time came third (24.6%) followed by hating to visit the doctor (6.9%).

3.6 Perceived Symptoms for antibiotics consumption

In Table 4, fever and common cold were among the most common symptoms in both Maadi and Shagret Mariam. In Maadi fever accounted for (67.5%, n = 204), followed by a common cold (62.6%, n = 189) and in Shagret Mariam fever was also the major symptom for taking antibiotics, accounting for 75.8% (n = 207), followed by having a common cold 61.2% (n = 167). Having a sore throat was the third most common symptom in both areas, in Maadi it accounted for (54.6%, n = 165) and 60.1% (n = 164) in Shagret Mariam.

In Maadi, coughing came as the fourth common symptom and accounted for (48%, n = 145) and ear ache represented 18.9% (n = 57) followed by dental problems 10.3% (n = 31). Gastrointestinal symptoms also accounted for taking antibiotics, and diarrhea represented 7% (n = 21), followed by cramping and stomach ache 5.6% (n = 17). Painful urination was 4.6% (n = 14), eye problems 1.7% (n = 5) followed by other symptoms 4.6% (n = 14). In Shagret Mariam, coughing was 53.8% (n = 147). Ear ache was also among the top symptoms accounting for 15.8% (n = 43), followed by having a headache 7.3% (n = 20) and having dental problems 5.9% (n = 16). In Shagret Mariam, diarrhea was 4.8% (n = 13), and cramping was 11.4% (n = 31). Painful urination accounted for 3.3% (n = 9) and other symptoms was 8.4% (n = 23).

Table 4 – Perceived Symptoms for antibiotics consumption

Symptoms for consuming Antibiotics	Maadi (1)	Shagret Mariam (2)
	402 (%)	400 (%)
Fever	204 (67.5%)	207 (75.8%)
Common cold	189 (62.6%)	167 (61.2%)
Sore throat	165 (54.6%)	164 (60.1%)
Cough	145 (48 %)	147 (53.8%)
Ear ache	57 (18.9%)	43 (15.8%)
Headache	29 (9.6%)	20 (7.3%)
Dental	31 (10.3%)	16 (5.9%)
Diarrhea	21 (7%)	13 (4.8%)
Cramp _Stomach ache	17 (5.6%)	31 (11.4%)
Painful urination	14 (4.6%)	9 (3.3%)
Eye problem	5 (1.7%)	1 (0.4%)
Skin problem	0	1 (0.4%)
Constipation	0	3 (1.1%)
Blood in stool	0	2 (0.7%)
Bloated	0	0
Nausea	3 (1%)	14 (5.1%)
Anal problem	2 (0.7%)	3 (1.1%)
Dehydration	0	0
Other	14 (4.6%)	23 (8.4%)

3.7 Participants' Behavior

In Maadi, all participants who took antibiotics in the last six months 100% (n = 302) took the dose as frequently as recommended either by the physician or the leaflet of the antibiotic. In Shagret Mariam, 98.5% (n = 270) took the dose as frequently as recommended. Regarding sticking to the duration for the whole course of antibiotics, in Maadi 99% (n = 299) followed the course of antibiotics as recommended and 93.1% (n = 255) did follow the course in Shagret Mariam. In Maadi, 96.1% (n = 374) said that yes antibiotics treat viruses and bacteria both and 1.5% (n = 6) said no they do not treat viruses and bacteria and 2.3% (n = 9) did not know if antibiotics treat viruses and bacteria or not. In Shagret Mariam 83.5% (n = 334) said yes antibiotics treat viruses and bacteria both, 1% (n = 4) said no they do not treat viruses and bacteria and 15.5% (n = 62) said they do not know. In Maadi, 3.5% (n = 14) said they went to another physician to get antibiotic prescription when the first one did not prescribe them one and 96.5% (n = 388) said no they did not. In Shagret Mariam, 2.5% (n = 10) said they went to another physician to get antibiotics while 97.5% (n = 389) said they did not. In Maadi, 35.1% (n = 141) did took diarrheal medication in the last 3 months and 19.2% (n = 77) did took constipation medication in the last 3 months while in Shagret Mariam 20.8% (n = 83) did took diarrheal medication and 3% (n = 12) took constipation medication in the last 3 months. In Maadi, 11.4% (n = 46) had a history of ulcer while it was 6.5% (n = 26) in Shagret Mariam.

Table 5 – Participants behavior for taking antibiotics

		Maadi (1)	Shagret Mariam (2)
Variable		402 (%)	400 (%)
Frequency of the dose as recommended	Yes	302 (100%)	270 (98.5%)
Duration as recommended	Yes	299 (99%)	255 (93.1%)
Antibiotics treat viruses & bacteria	Yes	374 (96.1%)	334 (83.5%)
	No	6 (1.5%)	4 (1%)
	Do not know	9 (2.3%)	62 (15.5%)
Going to another physician to get antibiotics	Yes	14 (3.5%)	10 (2.5%)
Diarrheal meds in last 3 months	Yes	141 (35.1%)	83 (20.8%)
Constipation meds in the last 3 months	Yes	77 (19.2%)	12 (3%)
History of ulcer	Yes	46 (11.4%)	26 (6.5%)

3.8 Classes of Antibiotics

Amoxicillin was the most used class of antibiotic in both areas; in Maadi, it accounted for 60.7% of respondents (n = 184) and in Shagret Mariam it was 48.2% (n = 132). Moreover, in Maadi, 19.1% (n = 58) did not know which type of antibiotics they took and 31.8% (n = 87) of Shagret Mariam did not also know what kind of antibiotics they used. In Maadi, Penicillin was the second most used antibiotics with 8.9% (n = 27) of the people using it, followed by Cefotaxime 7.9% (n = 24), Nifuroxazide 5.6% (n = 17), and Metronidazole and Azithromycin, botheach accounting for 5.3% (n = 16). In Shagret Mariam, Cefotaxime was the second most used antibiotics after Amoxicillin with 8.4% (n = 23) of the people using it, followed by Metronidazole 5.1% (n = 14), followed by Nifuroxazide 4.4% (n = 12) and Penicillin and Azithromycin were 4% (n = 11).

Table 6 – Antibiotics that are mostly consumed in the two selected areas

	Maadi (1)	Shagret Mariam (2)
Variable	402 (%)	400 (%)
Don't know	58 (19.1%)	87 (31.8%)
Penicillin	27 (8.9%)	11 (4%)
Amoxicillin	184 (60.7%)	132 (48.2%)
Metronidazole	16 (5.3%)	14 (5.1%)
Nifuroxazide	17 (5.6%)	12 (4.4%)
Ciprofloxacin	0.0	2 (0.7%)
Azithromycin	16 (5.3%)	11 (4%)
Clindamycin	6 (2%)	2 (0.7%)
Acyclovir	0.0	0.0
Cephalosporins	0.0	0.0
Cefotaxime	24 (7.9%)	23 (8.4%)
Quinolones	0.0	0.0
Fluoroquinolones	0.0	0.0
Tetracyclines	3 (1%)	2 (0.7%)
Aminoglycosides	2 (0.7%)	3 (1.1%)
Co-trimoxazole	0.0	1 (0.4%)

3.9 Significance of Differences between the Two Areas (T-test)

T-test of percentage was done using SPSS 21.0 to assess if there is a significant difference between the different variables in the two selected areas of Maadi and Shagret Mariam. The t-test examined the significance difference for the variables (Table 7) below. Chi-square test was also done to check if there is significant difference between education levels in the two areas (Table 8) and found a significant difference ($p = 0.000$). Another Chi-square was done to assess if there is a significant difference between levels of income in the two areas and found a significant difference (p = 0.000). Employment status was in the two areas was found to be significantly different as well (p = 0.000).

Table 7 showing the p values of T-test of Percentage for Significance on different variables.

Variables	p Value
Residency and Having children	0.000***
Residency and Self-reported health	0.047*
Residency and Having a Chronic Illness	0.006**
Residency and Having Health Insurance	0.000***
Residency and Smoking	0.000***
Residency and Antibiotics Consumption in Adults	0.033*
Residency and Antibiotics Consumption for children/care givers	.140
Residency and Total Consumption of Antibiotics per Family	0.037*
Residency and SMA	0.000***
Residency and Antibiotics treats viruses and bacteria	0.000***
Residency and frequency of taking antibiotics	0.035*
Residency and duration of antibiotics	0.000***
Residency and going to another physician	0.418

*p<0.05 **p<0.01 ***p<0.0001

3.10 Testing of Significant Correlations

3.10.1 Testing Correlation between SMA and Level of Education

Chi-square test of independence was performed to examine the relation between SMA and level of education in both areas. The test indicated that there is a significant relationship between SMA and level of education in general (p = 0.000). When looking at each area, in

Shagret Mariam only there was a significant relationship; X^2 (2) =11.13, $p < 0.04$). With lower levels of education, there is a higher rate of SMA in Shagret Mariam. However, in Maadi, the relationship between education and SMA was found to be insignificant ($p = 0.819$)

3.10.2 SMA and Residency (Socioeconomic Level)

Another chi-square test of independence analyzed the relationship between residency and rate of SMA and showed a significant correlation between the two variables where X^2 (1) =82.62, $p < 0.00$). The rate of SMA was found to be significantly correlated to residency (socioeconomic level). Significantly higher rates of SMA was found more common in the low-income area compared to the high-income area.

3.10.3 SMA and Gender

Chi-square test of independence showed insignificant relationship between SMA and gender where X^2 (1) =0.968, $p < 0.325$).

3.10.4 SMA and Having Health Insurance

Chi-square test of independence showed a significant relationship between SMA and having a medical insurance where X^2 (1) =25.73, $p < 0.000$).

3.10.5 SMA and Employment

Chi-square test of independence showed insignificant relationship between SMA and employment where X^2 (2) =4.91, $p < 0.086$).

3.10.6 SMA and Marital status

Chi-square test of independence showed a significant relationship between SMA and marital status where X^2 (3) =15.12, $p < 0.002$).

3.10.7 SMA and Income

Chi-square test of independence showed also a significant relationship between SMA and levels of income where X^2 (1) =76.5, $p < 0.000$).

Table 8 showing Chi-square test results reflecting the significant relationships between SMA and other variables / Residency and other variables

Chi-square	p-value
SMA and Level of Education	0.000***
SMA and Residency	0.000***
SMA and Gender	0.325
SMA and having health insurance	0.000***
SMA and employment status	0.086
SMA and marital status	0.002**
SMA and income	0.000***
Residency and Education level	0.000***
Residency and Income level	0.000***
Residency and employment	0.000***

*p<0.05 **p<0.01 ***p<0.0001

3.11 Significant relationships between residency and education, income and employment

Table 8 above shows chi-square results indicating a significant correlation between residency and education level (X^2 (5) =214.3, $p < 0.000$). Also a significant correlation was found between residency and income (X^2 (6) =754.7 $p < 0.000$). Employment also showed a significant correlation with residency (X^2 (4) =37.7, $p < 0.000$).

3.12 Logistical Regression – Determinants of SMA

In Table 10, the first regression model shows that income and education have significant p-values when excluding the residency factor from the model. Reflecting that income and education are both factors contributing to SMA prevalence. The second model shows significant values for residency and for education without the income. The third regression model included income, education and the area of residency which showed in earlier models significant values. In this third model, when adding the three factors together, the only factor showing significance is education.

Regression Model 1 | Regression Model 2 | Regression Model 3

	B	S.E.	Sig.	Exp(B)		B	S.E.	Sig.	Exp(B)		B	S.E.	Sig.	Exp(B)
Gender	.149	.217	.491	1.161	**Residency**	-1.543	.239	.000***	.214	**Gender**	.167	.218	.444	1.182
Having children	-.274	.293	.349	.760	**Gender**	-.121	.215	.573	.886	**Having children**	-.249	.295	.400	.780
Having chronic illness	.320	.346	.355	1.378	**Having children**	.265	.294	.367	1.304	**Having chronic illness**	.237	.351	.499	1.268
Income			.000***		**Education**			.018*		**Income**			.348	
Income (1)	-1.362	.270	.000***	.256	**Education (1)**	1.001	.354	.005**	2.721	**Income (1)**	.074	.837	.930	1.077
Income (2)	-1.610	.271	.000***	.200	**Education (2)**	.297	.233	.202	1.346	**Income (2)**	-.293	.795	.712	.746
Education			.005**		**Having chronic illness**	-.236	.350	.501	.790	**Education**			.010*	
Education (1)	-1.166	.358	.001**	.312	**Constant**	-.597	.308	.053	.551	**Education (1)**	-1.086	.361	.003**	.338
Education (2)	-.363	.231	.117	.696						**Education (2)**	-.312	.234	.182	.732
Constant	2.158	.330	.000	8.653						**Residency**	1.466	.804	.068	4.330
										Constant	.660	.880	.453	1.935

*p<0.05 **p<0.01 ***p<0.0001

Table 10 Showing 3 regression models. Regression model # 1 - included: Gender, having children, Having chronic illness, Education and Income. Regression model # 2 – including area, having children, gender, Having chronic illness, and Education (excluding income). Regression model # 3 - included: area, gender, having children, Having chronic illness, income and Education).

Summary of the Results

The main findings of the research are the high prevalence of SMA which was found to be four times more in the low-income area of Shagret Mariam (47.4% (n = 130) than in the high-income area 12.9% (n = 39) of Maadi. Total consumption of antibiotics (regardless of SMA practice) was significantly higher (p = 0.037) in the high-income area of Maadi 75.1% (n = 302) compared to 68.5 % (n = 274) in Shagret Mariam. Significant correlation was found between prevalence of SMA and the area (residency) (p = 0.00) where higher rates of SMA was found more common in the low-income area compared to the high-income area. Another significant correlation was found between SMA practice and levels of education in Shagret Mariam (p = 0.04) where with lower levels of education, there was a higher prevalence of SMA. The study also showed that the main reason for SMA in both areas was having a previous experience with similar symptoms; 79.5% (n = 31) in Maadi and 89.2% of respondents (n = 116) in Shagret Mariam. In the low-income area, the second main reason was cost of physician 50.8% (n = 66) compared to saving time 25.6% (n = 10) in Maadi. Amoxicillin was the most consumed antibiotics in Maadi 60.7% (n = 184) and 48.2% (n = 132) in Shagret Mariam. From running three different regression models, education always showed significance with other factors. However, when combining income and education, income also showed significant values and when combining area of residency with education, area showed significant values. Yet adding residency and income together in one model did not account for any significant values.

Discussion

4.1 Demographic Background

A total of 802 questionnaires were completed with higher response rates in the low-income area; Shagret Mariam 82% (n = 488) compared to 66% (n = 609) in Maadi. One of the reasons for lower response rate in Maadi was that Maadi residents seemed to be more in a hurry, while Shagret Mariam residents would be curious more to stop and participate. Interestingly, females were more willing than the males to participate in the study in both Maadi and Shagret Mariam which accounted for 61.2% (n = 246) in Maadi and 65% (n = 260) in Shagret Mariam. The female researcher was stationed in Shagret Mariam and the male researcher was in Maadi so it did not affect the gender of participants because similar percentage of women were found at the two areas. Educational levels were higher in Maadi than in Shagret Mariam, which was expected given the different socioeconomic levels between the two areas with being a university graduate as the majority of Maadi's 74.1% (n = 298) compared to having a high school degree 48.5% (n = 194) as the most dominant educational level in Shagret Mariam. Income varied significantly between the two areas which supported the socioeconomic difference of the two populations as expected before conducting the study where 94% (n = 373) of the salaries in Shagret Mariam were below 6000 EGP per month compare to 90% of salaries in Maadi more than 8000 EGP per month. These results reflected the socioeconomic level difference of the two populations and confirms the categorization of the APDI index as indicated by Khadr et al., 2010.

4.2 Self-Reported Health & Insurance

Regarding self-reported health, 88.6% (n = 356) of the Maadi population believed that their health is ranked as good. In Shagret Mariam, 92.5% (n = 370) believed that health is good. The difference of the reported health status between the two areas was significant and it might be due to socioeconomic difference where the population in Maadi have more resources and awareness of their health and access to healthcare evaluation more than those in Shagret Mariam with limited economic resources and awareness. In Maadi, 13.4% (n = 54) had a chronic illness compared to 7.5% (n = 30) in Shagret Mariam and this significant difference might be also due to again the socioeconomic gap and access to healthcare. Rates of diagnoses of chronic illness were higher in Maadi because of resource availability and access to healthcare services unlike in Shagret Mariam where participants did not have the same privilege. This difference could explain the gap in the rates of chronic illnesses. The most common chronic disease in both areas was high blood pressure, followed by diabetes, and heart diseases. The rates of chronic diseases were significantly higher (double) in Maadi than in Shagret Mariam which was expected to be the opposite, however, this might be again due to having access to healthcare and accordingly having proper diagnosis. As Maadi is a high-income area with higher socioeconomic status, population of Maadi have access to healthcare units and proper medical diagnosis more than in Shagret Mariam.

Maadi's population had four times the rate of health/medical insurance than in Shagret Mariam where 51.2% (n = 206) of Maadi residents had health insurance compared to only 12.5% (n = 50) in Shagret Mariam. The significant gap in having a health insurance reflected the socioeconomic level difference between the two areas. When running a correlation test, having health insurance was not significantly related to SMA. This could be due to the fact that antibiotics are easily accessible with or without health insurance plans and patients can get them from any pharmacy whether it is low or high-income area. In the low-income area, where prevalence of SMA was four times more likely than in the high-income, percentage of people with health insurance was only 12.5%. Therefore, even with low percentage of health insurance coverage in Shagret Mariam, there was still high SMA prevalence indicating that health insurance did not affect the SMA practice. These results were similar to the study in Jordan, where health insurance and SMA showed insignificant relationship (Sawair et al., 2009). The full 100% coverage was provided to 24.6% (n = 51) of the population in Maadi compared to 12% (n = 6) only in Shagret Mariam reflecting the type of coverage the two populations had. From these results, it seemed that even those in the low-income area of Shagret

Mariam, having health insurance did not mean full coverage or access since more than 54% had only limited access of 50-70% in Shagret Mariam, yet in Maadi, the most common coverage was full 100% coverage for 41.5% (n = 86). Regarding smoking, a significant difference was found between the two areas where 34.3% (n = 138) of Maadi were smokers compared to 23% (n = 92) in Shagret Mariam which was the opposite of what was expected.

4.3 Prevalence of Antibiotic Use, SMA and Socioeconomic Level

Consumption of antibiotics among adult study participants was 24.1% (n = 97) in Maadi, which was significantly higher than in Shagret Mariam 18% (n = 72). Consumption in Maadi for participants who had given their children/care receiver was also higher in Maadi 67.2% (n = 205) than in Shagret Mariam 61.6% (n = 202) yet it was not a significant difference. The total consumption rate per family/household in the high-income area of Maadi was 75.1% (n = 302) which was significantly higher than in the low-income area of Shagret Mariam where total consumption was 68.5% (n = 274). Each household in Maadi consumed more antibiotics than in Shagret Mariam. The total consumption of antibiotics means consumption by the adult who participated in the study or by his children/care receiver in the household and the total consumption includes both prescribed antibiotics (by physician) and self-medicated antibiotics. It was hypothesized that total consumption/use of antibiotics would be higher in Shagret Maraim than in Maadi however, the results showed the opposite. Reasons that might be contributing to the higher level of consumption in Maadi than in Shagret Mariam is the wider access to healthcare resources and physicians, having health insurance plans with more coverage and having higher socioeconomic level explains affordability of antibiotics and also access to physician prescriptions. In Shagret Mariam, 12.5% (n = 50) had health insurance plans compared to 51.2% (n = 206) in Maadi. Population in Shagret Mariam also had less salaries and lower socioeconomic level to afford to visit a physician. Affordability was also shown as a factor contributing to SMA because it is more affordable for low-income communities to practice SMA than to visit a physician (Ocan et al., 2015).

Although the consumption of antibiotics was significantly higher in Maadi than in Shagret Mariam, the prevalence of self-medication SMA without prescription was almost four times significantly higher (p value = 0.00) in Shagret Mariam than in Maadi. As one of the main objectives of this study, the prevalence of SMA was estimated in both areas. As illustrated in Table 2, SMA in Maadi was 12.9% (n = 39) which means that 12.9% in Maadi of those who consumed antibiotics in the last six months practiced SMA compared to 47.4% (n = 130) in Shagret Mariam. These results resonated with a similar study in Beirut where antibiotic dispensing without prescription was higher in the lower socio-economic areas than the higher-socioeconomic areas (Farah et al., 2015). This gap between SMA in Maadi and Shagret Mariam can be associated with level of awareness about antibiotics uses, not having health insurance plans which makes it hard for people to go see a physician. These findings agreed with the hypothesis that higher rates of SMA are to be found in the lower-socioeconomic areas with lower educational level and limited healthcare services.

4.4 Reasons for SMA & the Socioeconomic Level

As illustrated in Table 3 above, the main reasons for SMA in the both low-income area of Shagret Mariam and the high-income area of Maadi was participants' previous experience with similar symptoms or diseases which accounted for 89.2% (n = 116) in Shagret Mariam and 79.5% (n = 31) in Maadi. Sawair et al., 2009 also found that patients' past experience with similar illness/symptoms was among the main reasons for SMA along with saving time. Saving time came as the second reason for SMA but only in the high-income area of Maadi 25.6% (n = 10) However, in the low-income area of Shagret Mariam the cost of physician represented the second main reason for SMA with 50.8% (n = 66) of the population. Cost of physicians was also indicated as a main reason for practicing SMA in low-socio economic settings in Guatemala (Ramay et al., 2017) which is in concord with the study findings. Interestingly cost of physician represented only in Maadi came as the third reason and accounted for 5.1% (n = 2). A significant correlation was found between the two selected areas (socioeconomic level) and SMA behavior (p=0.00) where higher rates of SMA without prescription was four times more likely in thelow-income area (Shagret Mariam) than in the high-income area (Maadi). The two selected areas had significant socioeconomic level differences and finding this correlation resembled findings from previous studies showing that socioeconomic difference is correlated with SMA behavior. In Lithuania, populations in rural areas consumed 1.79 times more antibiotics without prescription than in urban areas (Berzanskyte et al., 2006). Poverty in LMICs is correlated with self-medication behavior as indicated by Bloom et al., (2015) where findings showed that it was more affordable to self-medicate rather than visit a physician first as well as results from Ramay et al., 2017. In Beirut, 32% of antibiotics were dispensed without prescription in low-income areas (Farah et al., 2015) and in Syria, people from low and medium-incomes showed higher SMA rates (Barah & Gonçalves, 2010). The results corresponded similarly with the findings of Hadi et al., 2016 in Saudi Arabia where an inability to afford a consultation with a physician was the most common reason for dispensing antibiotics without prescription representing 65.3%. In Tanzania, lack of affordability was also contributing to self-medication with antimalaria due (Chipwaza et al., 2014).

4.5 Perceived Symptoms for Antibiotics Consumption

As shown in Table 4, variety of symptoms that triggered participants to consume antibiotics. In both low and high-income areas, some of the main symptoms were having fever, common cold and sore throat respectively. In Maadi, fever represented 67.5% (n = 204), common cold was 62.6% (n = 189), sore throat was 54.6% (n = 165), and cough respectively. In Shagret Mariam fever was 75.8% (n = 207), common cold was 61.2% (n = 167), sore throat was 60.1% (n = 164) and cough was 53.8% (n = 147) respectively. In Iran, common cold was also shown to be the main symptom for SMA with 48% of those who self-medicated (Heidarifar et al., 2013). A viral infection often causes fever, yet it was the most frequent symptom that causing participants to consume antibiotics (Llor & Bjerrum, 2014). Consuming antibiotics for fever was reported before in Gulf countries as the first treatment option people turn to when having fever (Aly & Balkhy, 2012).

Respiratory infections whether bacterial or viral seem to be the main cause for the common symptoms of fever, common cold, sore throat, and cough. However, fever was the most common symptom. Common cold was also a symptom that majority of physicians (64%) and pharmacists (81%) in Minya, Egypt prescribed antibiotics for (Dooling et al., 2014). Data from the low and high-income areas conformed to data from Jordan where more than 60% of patients also took antibiotics to treat common cold (Shehadeh et al., 2012). Ear ache, headache, and dental problems, 15.8% (n = 43), 7.3% (n = 20) and 5.9% (n = 16) respectively, were also among the symptoms of those taking antibiotics but were not as common. Additionally, In Shagret Mariam, diarrhea was 4.8% (n = 13), and cramping was 11.4% (n = 31).

4.6 Participants behavior for taking antibiotics

Understanding how participants consumed antibiotics in terms of frequency and the duration in both areas were examined. In both low and high-income areas, majority of participants who took antibiotics did use the drug as frequently as recommended. In the high-income area, all those who consumed antibiotics in the last six months (n = 302) stated that they took the dose of antibiotics as per the recommended frequency whether by the advice of the physician or by the leaflet of the medication in case of SMA and 98.5% (n = 270) in the low-income area. Regarding adherence to the course of antibiotics, surprisingly both populations had a greater than 90% adherence to the course of antibiotics with no significant difference. Adhering to the course of antibiotics in both areas might be associated with overuse behavior without knowledge about the dangers of antibiotics. These results were the opposite of what was hypothesized before conducting the study. A study in Minya, Egypt showed that some people preferred to take antibiotics for prophylactic purposes whenever they need rather than the long course of treatment (Kandeel et al., 2014). Fernandes et al., 2014 showed that non-adherence to antibiotics was common in Lisbon with 57.7% prevalence.

Part of this study was to assess the knowledge of participants about antibiotics role in treating viruses and bacteria in the two areas. In the high-income area, 96.1% (n = 374) stated that antibiotics treat both viruses and bacteria, only 1.5% (n = 6) said antibiotics do not treat both viruses and bacteria, and 2.3% (n = 9) did not know if antibiotics treat viruses and bacteria or not. In the low-income area 83.5% (n = 334) agreed that antibiotics treat both viruses and bacteria and 1% (n = 4) stated that antibiotics do not and 15.5% (n = 65) said they do not know. It was expected that more awareness about the use and role of antibiotics in treating bacteria and viruses would be common in Maadi however results showed there was little knowledge about the difference between viruses and bacteria and what antibiotics can treat. Additionally, a large percent 15.5% of the population in the low-income area stated that they do not know if antibiotics treat bacteria and viruses or not compared to only 1.5% in Maadi who said the same. Little/no knowledge about antibiotics role in treating bacterial and viral infection was common among the two populations. In Egypt, Kandeel et al., 2014, revealed that parents (caregivers) preferred giving antibiotics as a prevention for common cold (Kandeel et al., 2014) and in Jordan, 28.1% misused antibiotics as pain killers, and 55.6% used them as preventive treatment (Shehadeh et al., 2012). Similar findings from Lithuania showed that 26.0% of Lithuanians thought antibiotics were effective against viral infections and 61% of them did not have the knowledge about what antibiotics do (Pavydė et al., 2015). Yet, in Sweden, only 19.1% who agreed that antibiotics cure common colds/ viral infection (André et al., 2010). These findings reflect that the socioeconomic level of the population reflects the knowledge and understanding of antibiotics as shown in this research and by Shehadeh et al., 2012.

Surprisingly, in the high-income area, 3.5% (n = 14) of participants said that went to another physician when the first one did not prescribe them with antibiotics compared to 2.5% (n = 10) who did the same in the low-income area. The reason might be contributed to the fact that more people from the high-income area have already access to physicians unlike the population in the low-income area where there is limited access. The population in Maadi thus had the resources and affordability to visit more than one physician given the socioeconomic difference between the two areas and the fact that cost to visit physician was one of the main reasons for SMA in the low-income area.

4.7 Types of Antibiotics Consumed

In the high-income area, 19.1% (n = 58) did not know which type of antibiotics they took compared to 31.8% (n = 87) in the low-income area. However, the most used class of antibiotics in both high and low-income areas was Amoxicillin, with 60.7% (n = 184) usage in Maadi and 48.2% (n = 132) in Shagret Mariam. Amoxicillin was also the most used antibiotic in Abu Dhabi with 46.3% (Abasaeed et al., 2009). Khalil et al., 2013 showed also that Amoxicillin was the most used antibiotics by Saudi patients (86.6%) for dental problems. These results agreed with the findings of Elhassan et al., 2016 whose findings showed that Amoxicillin was among the generic affordable antibiotics available. Amoxicillin was the most consumed antibiotics for self-medication in Greece (Skliros et al., 2010). The second most commonly consumed antibiotic was different in the two areas, where in the high-income part, Penicillin 8.9% (n = 27) ranked second and in the low-income area, it was Cefotaxime 8.4% (n = 23).

4.8 Education and SMA

A significant correlation was found between educational level and SMA in the low-income area, indicating that with a lower educational level, there is a higher SMA behavior. These results conformed with studies by (Awad & Aboud, 2015; Barah & Gonçalves, 2010; & Jose et al., 2013) in which educational level was significantly related to SMA in Kuwait, Syria, and Oman respectively. Alhomoud et al., (2017) has also showed that lower levels of education were correlated with an increase in prevalence of SMA. SMA in Haiti was significantly lower among patients who had a university degree compared to those who were illiterate (Moise et al., 2017). However, data in the high-income area in Maadi did not show a significant correlation between educational level and SMA. These results might be due to the fact that SMA prevalence was relatively low in Maadi compared to Shagret Mariam and therefore educational background did not show a significant correlation. These results between education and SMA in the high-income area relates to the findings in Abu Dhabi, Sudan and Alexandria, Egypt, where the rates of SMA were higher among those with higher educational level (Abasaeed et al., 2009; Awad et al., 2005; Sallam et al., 2009).

4.9 Determinants of SMA

When running three logistical regression models and accounting for different factors, education showed one fixed determinant that is significantly contributing to SMA. Income also is another factor however when adding income to the same model that has residency, it did not show any significance. Income and residency seems to affect each other which indicated that they both represent the same factor (socioeconomic difference). These results reflect that SMA's determinants are education, and income (socioeconomic level).

Limitations and Drawbacks

One of the challenges of the study was finding a suitable questionnaire that has been used and validated before. Contacts have been made with researchers in Lithuania, Lebanon, UK, and Egypt and some of them answered back. All these studies had similar objectives which is to assess the status and prevalence of SMA. The most time-consuming step was also finding the criteria for selecting low and high-income areas. Examination of government and national publications on socioeconomic categorization of areas in Egypt was not easy to find. Cairo has many informal settlements with different criteria so identifying only low and high-income area was a challenge. Finding the work of Dr. Khadr has helped significantly in overcoming this issue.

Another difficulty was the low response rate in the high-income area of Maadi. Finding and recruiting participants for the study in Maadi took a longer time than in Shagret Mariam with three more days of field work. Some of the questions in the questionnaire could have been asked differently or skipped. One of the questions was employment which had five choices as adopted from the original questionnaire however, if it would have been asked with only two choices "working/not working" would have been more efficient since there was no need for all the other categories of non-working. "Did you stick to the duration and frequency of antibiotics?" might have been confusing to explain the difference between frequency and duration of the course of antibiotics. Another question that could have been simpler was "Do antibiotics treat viruses and bacteria?" this question could have been divided into two questions, one about antibiotics treating bacteria and another one if antibiotics treat viruses so not to confuse participants especially given the high response that antibiotics treat both bacteria and viruses. The question on the number of children might have been extra that was not needed. Another one was the questions on diarrhea, constipation, and ulcer, they were not specific and were a repetition to question #23 where a list of perceived symptoms was provided and included gastrointestinal symptoms. The income question was put as a range so that participants would respond honestly however, it would have been more useful to have the salary as a number (continuous variable) for the statistical analysis on SPSS later.

Some of the challenges also were finding the pharmacies as per the criteria; non-chain pharmacy, located within the selected area on the map and getting owners' consent. Maadi especially as a high-income area had more chain pharmacies than non-chain. In Shagret Mariam, non-chain pharmacies were more common than chain-ones. When entering the data manually, numbers and codes should have been the only information entered, however some wording was also added to the excel sheet. After thorough review for few days, the data was re-organized into codes and numbers and the words were replaced with the codes. Study was conducted in the month of September which might affect the rate of consumption of antibiotics. In the winter, common cold and flu are common and so is the consumption of antibiotics and in the summer, heat also contributes to increasing some infection disease especially gastrointestinal (Lin et al., 2016) and therefore, the time when the study was conducted might be a factor.

Conclusion & Recommendation

As per the findings of this study, prevalence of SMA was found to be four times higher in the low-income area compared to the high-income area reflecting the significance of the socioeconomic level and education level affecting the prevalence of SMA. However, consumption of antibiotics per family was significantly higher in the high-income area more than in the low-income area. Reasons for SMA were having previous experience with the disease/symptoms yet cost of physician was the second main reason in the low-income setting compared to saving time as the second reason in the high-income setting. Lack of knowledge about antibiotics effectiveness in treating bacterial and viral infections was found to be common in both high and low-income areas. The most common used antibiotic was Amoxicillin.

As observed in this study, SMA prevalence was high especially in low-income settings due to the socioeconomic difference reflected in the two areas selected; Maadi and Shagret Mariam. The prevalence of SMA was higher in low-income areas reflecting that it is a contributing factor. A follow up study to examine the SMA behavior with AMR prevalence in the population of both areas; high and low-income, would validate the relationship between SMA and development of resistance. Such a study would include behavioral and clinical assessment. From the findings, limited access to physician due to the cost and lack of health insurance coverage is a factor contributing to SMA behavior. Thus, facilitating access to affordable healthcare especially in low-income settings would hopefully decrease the prevalence of SMA in poorer areas. The SMA behavior is complex and many factors are involved. Another important recommendation is educating the public about the long-term dangers of antibiotics on a national scale which can be successful such as Egypt's campaign on vaccination. From a legal perspective, understanding the regulatory framework of antibiotic dispensing in Egypt would be another study to better recommend and enforce regulations that would limit SMA. It would be also useful to conduct the same study over a year-long to put into account the seasonal variations and the rate of antibiotic consumptions. Further research should be done also to assess the rate of prescription by physicians and pharmacists which would provide a different perspective on the issue. Since physicians and pharmacists also prescribe unnecessary antibiotics sometimes with no proper appropriateness.

References

Abasaeed, A., Vlcek, J., Abuelkhair, M., & Kubena, A. (2009). Self-medication with antibiotics by the community of Abu Dhabi Emirate, United Arab Emirates. *Journal of Infection in Developing Countries*, *3*(7), 491–497. https://doi.org/10.3855/jidc.466

Abdallah, H. M., Alnaiemi, N., Reuland, E. A., Wintermans, B. B., Koek, A., Abdelwahab, A. M., … Vandenbroucke-Grauls, C. M. J. E. (2017). Fecal carriage of extended-spectrum β-lactamase- and carbapenemase-producing Enterobacteriaceae in Egyptian patients with community-onset gastrointestinal complaints: a hospital -based cross-sectional study. *Antimicrobial Resistance & Infection Control*, *6*(1), 62. https://doi.org/10.1186/s13756-017-0219-7

Abdel-Maksoud, M., El-Shokry, M., Ismail, G., Hafez, S., El-Kholy, A., Attia, E., & Talaat, M. (n.d.). Methicillin-Resistant Staphylococcus aureus Recovered from Healthcare-and Community-Associated Infections in Egypt. https://doi.org/10.1155/2016/5751785

Aboderin, A. O., & Martinez, E. (2016). East Africa Public Health Laboratory Networking Project Strengthening the Role of Laboratories in Tracking Antimicrobial Drug Resistance in East Africa. Retrieved from https://www.cddep.org/wp-content/uploads/2017/06/wb_report_32-1.pdf

Aboul Fotouh, A. M., el-Damaty, S. E., & Abdel Megeid, F. Y. (1998). Mother's knowledge about antibiotic and role of self prescription. *The Journal of the Egyptian Public Health Association*, *73*(1–2), 57–69. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/17249211

Adegbola, R. A., DeAntonio, R., Hill, P. C., Roca, A., Usuf, E., Hoet, B., & Greenwood, B. M. (2014). Carriage of Streptococcus pneumoniae and other respiratory bacterial pathogens in low and lower-middle income countries: A systematic review and meta-analysis. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0103293

Ahmed, M. M., Velayati, A. A., & H.Mohammed, S. (2016). Epidemiology of multidrug-resistant, extensively drug resistant, and totally drug resistant tuberculosis in Middle East countries. *International Journal of Mycobacteriology*, *5*(3), 249–256. https://doi.org/10.1016/J.IJMYCO.2016.08.008

Akl, O. A., El Mahalli, A. A., Elkahky, A. A., & Salem, A. M. (2014). WHO/INRUD drug use indicators at primary healthcare centers in Alexandria, Egypt. *Journal of Taibah University Medical Sciences*, *9*(1), 54–64. https://doi.org/10.1016/j.jtumed.2013.06.002

Alhomoud, F., Aljamea, Z., Almahasnah, R., Alkhalifah, K., Basalelah, L., & Alhomoud, F. K. (2017). Self-medication and self-prescription with antibiotics in the Middle East—do they really happen? A systematic review of the prevalence, possible reasons, and outcomes. *International Journal of Infectious Diseases*, *57*, 3–12. https://doi.org/10.1016/j.ijid.2017.01.014

Al-Lawati, A. M., Crouch, N. D., & Elhag, K. M. (2000). Antibiotic consumption and development of resistance among gram-negative bacilli in intensive care units in Oman. *Annals of Saudi Medicine*, *20*(3–4), 324–7. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/17322694

Allegranzi, B., Bagheri Nejad, S., Combescure, C., Graafmans, W., Attar, H., Donaldson, L., & Pittet, D. (2011). Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. *Lancet (London, England)*, *377*(9761), 228–41. https://doi.org/10.1016/S0140-6736(10)61458-4

Al-Tawfiq, J. A. (2006). Increasing Antibiotic Resistance Among Isolates of Escherichia coli Recovered From Inpatients and Outpatients in a Saudi Arabian Hospital. *Infection Control & Hospital Epidemiology*, *27*(7), 748–753. https://doi.org/10.1086/505336

Al-Tawfiq, J. A., Stephens, G., & Memish, Z. A. (2010). Inappropriate antimicrobial use and potential solutions: a Middle Eastern perspective. *Expert Review of Anti-Infective Therapy*, *8*(7), 765–774. https://doi.org/10.1586/eri.10.56

Al-Tawfiq, J. A., Stephens, G., & Memish, Z. A. (2010). Inappropriate antimicrobial use and potential solutions: a Middle Eastern perspective. *Expert Review of Anti-Infective Therapy*, *8*(7), 765–774. https://doi.org/10.1586/eri.10.56

Alvarez-Uria, G., Gandra, S., & Laxminarayan, R. (2016). Poverty and prevalence of antimicrobial resistance in invasive isolates. *International Journal of Infectious Diseases*. https://doi.org/10.1016/j.ijid.2016.09.026

Aly, M., & Balkhy, H. H. (2012). The prevalence of antimicrobial resistance in clinical isolates from Gulf Corporation Council countries. *Antimicrobial Resistance and Infection Control*. Retrieved from https://doi.org/10.1186/2047-2994-1-26

Al-Zarouni, M., Senok, A., Rashid, F., Al-Jesmi, S. M., & Panigrahi, D. (2008). Prevalence and antimicrobial susceptibility pattern of extended-spectrum beta-lactamase-producing enterobacteriaceae in the United Arab Emirates. *Medical Principles and Practice*. https://doi.org/10.1159/000109587

Andersson, D. I., & Hughes, D. (2012). Evolution of antibiotic resistance at non-lethal drug concentrations. *Drug Resistance Updates*, *15*(3), 162–172. https://doi.org/10.1016/J.DRUP.2012.03.005

André, M., Vernby, Å.˚, Berg, J., & Lundborg, C. S. (2010). A survey of public knowledge and awareness related to antibiotic use and resistance in Sweden. *Journal of Antimicrobial Chemotherapy*, *65*(6), 1292–1296. https://doi.org/10.1093/jac/dkq104

ANNUAL EPIDEMIOLOGICAL REPORT ON COMMUNICABLE DISEASES IN EUROPE 2008 REPORT ON THE STATE OF COMMUNICABLE DISEASES IN THE EU AND EEA/EFTA COUNTRIES. (2008). *European Center for Disease Prevention and Control ECDC* Retrieved from https://ecdc.europa.eu/sites/portal/files/media/en/publications/Publications/0812_SUR_Annual_Epidemiological_Report_2008.pdf

Ansari, S., Nepal, H. P., Gautam, R., Shrestha, S., Neopane, P., Gurung, G., & Chapagain, M. L. (2015). Community acquired multi-drug resistant clinical isolates of Escherichia coli in a tertiary care center of Nepal. *Antimicrobial Resistance and Infection Control*, *4*, 15. https://doi.org/10.1186/s13756-015-0059-2

Arabi, Y., Al-Shirawi, N., Memish, Z., Anzueto, A., Hollenbeak, C. S., Cox, M. J., & al., et. (2008). Ventilator-associated pneumonia in adults in developing countries: a systematic review. *International Journal of Infectious Diseases : IJID : Official Publication of the International Society for Infectious Diseases*, *12*(5), 505–12. https://doi.org/10.1016/j.ijid.2008.02.010

Arch G. Mainous III, P., Charles J. Everett, P., Robert E. Post, M., Vanessa A. Diaz, MD, M., & Hueston, W. J. (2009). Availability of Antibiotics for Purchase Without a Prescription on the Internet. *Ann Fam Med*, *7*, 431–435. https://doi.org/10.1370/afm.999

Awad, A. I., & Aboud, E. A. (2015). Knowledge, attitude and practice towards antibiotic use among the public in Kuwait. *PLoS ONE*, *10*(2), 1–15. https://doi.org/10.1371/journal.pone.0117910

Awad, A., Eltayeb, I., Matowe, L., & Thalib, L. (2005). Self-medication with antibiotics and antimalarials in the community of Khartoum State, Sudan. *Journal of Pharmacy and Pharmaceutical Sciences*, *8*(2), 326–331. https://doi.org/10.5455/pmb.1314892446

Babiker, M., Mustafa, S., Mohammed, M., Elrayah, M., & Marouf, L. (2017). Prevalence of MRSA nasal colonization among community members and healthcare workers at private and public hospitals in Khartoum State, Sudan. *Journal of Biomedical and Pharmaceutical Research*, *6*(3). Retrieved from http://jbpr.in/index.php/jbpr/article/view/648/708

Badawi, H., Diab, M. S., & Said, M. El. (2007). Impact of Antibiotic Policy in a Tertiary Care Research Institute Hospital in Egypt: Three Years' Experience. *International Journal of Infection Control*, *3*(2). https://doi.org/10.3396/IJIC.V3I2.2384

Balkhy, H. H., Assiri, A. M., AlMousa, H., Al-Abri, S. S., Al-Katheeri, H., Alansari, H., … Pittet, D. (2016). The strategic plan for combating antimicrobial resistance in Gulf Cooperation Council States. *Journal of Infection and Public Health*, *9*(4), 375–385. https://doi.org/10.1016/J.JIPH.2016.03.003

Balkhy, H., El-Saed, A., Al Johani, S., Tayeb, H., Al-Qahtani, A., Alahdal, M., … Alarabi, Y. (2011). Epidemiology of the first outbreak of carbapenem-resistant Klebsiella pneumoniae in Saudi Arabia. *BMC Proceedings*, *5*(Suppl 6), P295. Retrieved from https://doi.org/10.1186/1753-6561-5-S6-P295

Barah, F., & Gonçalves, V. (2010). Antibiotic use and knowledge in the community in Kalamoon, Syrian Arab Republic: a cross-sectional study. *Eastern Mediterranean Health Journal*, *16*(5), 516–21. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/20799551

Basseri, R. J., Weitsman, S., Barlow, G. M., Pimentel, M., Basseri, F., & Pimentel Director, M. (2011). Antibiotics for the Treatment of Irritable Bowel Syndrome Gut Ecology in Irritable Bowel Syndrome. *Gastroenterology & Hepatology*, *7*(7). Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3264894/

Benjamin, H., Smith, F., & Motawi, M. A. (1996). Drugs dispensed with and without a prescription from community pharmacies in a conurbation in Egypt. *Eastern Mediterranean Health Journal*. Retrieved from http://apps.who.int/iris/handle/10665/119417

Benmarhnia, T., Bailey, Z., Kaiser, D., Auger, N., King, N., & Kaufman, J. S. (2016). A Difference-in-Differences Approach to Assess the Effect of a Heat Action Plan on Heat-Related Mortality, and Differences in Effectiveness According to Sex, Age, and Socioeconomic Status (Montreal, Quebec). *Environmental Health Perspectives*, *124*(11). https://doi.org/10.1289/EHP203

Berzanskyte, A., Valinteliene, R., Haaijer-Ruskamp, F., Gurevicius, R., & Grigoryan, L. (2006). Self-Medication with Antibiotics in Lithuania. *International Journal of Occupational Medicine and Environmental Health*, *19*(4), 246–253. https://doi.org/10.2478/v10001-006-0030-9

Bhutta, Z. A., Sommerfeld, J., Lassi, Z. S., Salam, R. A., & Das, J. K. (2014). Global burden, distribution, and interventions for infectious diseases of poverty. *Infectious Diseases of Poverty*, *3*(21). https://doi.org/10.1186/2049-9957-3-21

Bloom, G., Wilkinson, A., Tomson, G., Awor, P., Zhang, X., Ahmed, S. M., Khan, W. A., Blessing, V., Wang, L., Liang, X. and Peterson, S. (2015) Addressing Resistance to Antibiotics In Pluralistic Health Systems, S TEPS Working Paper 84, Brighton: STEPS Centre. Retrieved from https://opendocs.ids.ac.uk/opendocs/handle/123456789/6416

Bolarinwa, O. (2015). Principles and methods of validity and reliability testing of questionnaires used in social and health science researches. *Nigerian Postgraduate Medical Journal*, *22*(4), 195. https://doi.org/10.4103/1117-1936.173959

Borg, M. A., Zarb, P., Ferech, M., & Goossens, H. (2008). Antibiotic consumption in southern and eastern Mediterranean hospitals: results from the ARMed project. *Journal of Antimicrobial Chemotherapy*, *62*(4), 830–836. https://doi.org/10.1093/jac/dkn260

Brief, A. R. P. (2015). Antibiotic Resistance. Because of overuse and misuse, some antibiotics are losing effectiveness against highly resistant bacteria. *Health Affairs*. https://doi.org/10.1377/hpb2015.6

Bronzwaer, S. L. A. M., Cars, O., Buchholz, U., Mölstad, S., Goettsch, W., Veldhuijzen, I. K., … Degener, J. E. (2002). The relationship between antimicrobial use and antimicrobial resistance in Europe. *Emerging Infectious Diseases*, *8*(3), 278–282. https://doi.org/10.3201/eid0803.010192

Brooke M. Ramay1, Luisa Córdova1, A. C. (2017). Self-medication with antibiotics in four Guatemala City pharmacies characteristics, sources of information, perceived effects, and motives. Retrieved from https://www.researchgate.net/publication/309236706_Self-medication_with_Antibiotics_in_four_Guatemala_City_pharmacies_Characteristics_Sources_of_Information_Perceived_Effects_and_Motives

Byarugaba, D. . K. (2004). Antimicrobial resistance in developing countries and responsible risk factors. *International Journal of Antimicrobial Agents*, *24*(2), 105–110. https://doi.org/10.1016/j.ijantimicag.2004.02.015

Centers for Disease Control and Prevention CDC. (2016). Carbapenem-resistant Enterobacteriaceae in Healthcare Settings | HAI | CDC. Retrieved June 25, 2017, from https://www.cdc.gov/hai/organisms/cre/index.html

Centers for Disease Control and Prevention CDC. (2017). Antibiotic / Antimicrobial Resistance. Retrieved from https://www.cdc.gov/drugresistance/about.html

Centers for Disease Control CDC. (2013). Antibiotic resistance threats in the United States, 2013. *Current*, 114. https://doi.org/CS239559-B

Central Agency for Public Mobilization and Statistics (CAPMAS). (2015). Household income expenditure and consumption survey Egypt. Retrieved from http://www.erfdataportal.com/index.php/catalog/129

Chamoun, K., Farah, M., Araj, G., Daoud, Z., Moghnieh, R., Salameh, P., … Lebanese Society of Infectious Diseases Study Group (LSID study group). (2016). Surveillance of antimicrobial resistance in Lebanese hospitals: retrospective nationwide compiled data. *International Journal of Infectious Diseases*, *46*, 64–70. https://doi.org/10.1016/j.ijid.2016.03.010

Chang, Q., Wang, W., Regev-Yochay, G., Lipsitch, M., & Hanage, W. P. (2015). Antibiotics in agriculture and the risk to human health: how worried should we be? *Evolutionary Applications*, *8*(3), 240–7. https://doi.org/10.1111/eva.12185

Cheaito, L., Azizi, S., Saleh, N., & Salameh, P. (2014). Assessment of self-medication in population buying antibiotics in pharmacies: A pilot study from Beirut and its suburbs. *International Journal of Public Health*, *59*(2), 319–327. https://doi.org/10.1007/s00038-013-0493-y

Chipwaza, B., Mugasa, J. P., Mayumana, I., Amuri, M., Makungu, C., Gwakisa, P. S., … Shah, A. H. (2015). A study assessing public knowledge, belief and behavior of antibiotic use in an Omani population. *PLoS ONE*, *8*(2), 252. https://doi.org/10.1371/journal.pone.0117910

Chipwaza, B., Mugasa, J. P., Mayumana, I., Amuri, M., Makungu, C., & Gwakisa, P. S. (2014). Self-medication with anti-malarials is a common practice in rural communities of Kilosa district in Tanzania despite the reported decline of malaria. *Malaria Journal*, *13*(1), 252. https://doi.org/10.1186/1475-2875-13-252

Ciric, L., Mullany, P., & Roberts, A. P. (2011). Antibiotic and antiseptic resistance genes are linked on a novel mobile genetic element: Tn6087. *Journal of Antimicrobial Chemotherapy*, *66*(10), 2235–2239. https://doi.org/10.1093/jac/dkr311

Coates, A. R., Halls, G., & Hu, Y. (2011). Novel classes of antibiotics or more of the same? *British Journal of Pharmacology*. https://doi.org/10.1111/j.1476-5381.2011.01250.x

Coenen, S., Francis, N., Kelly, M., Hood, K., Nuttall, J., Little, P., … Worby, T. (2013). Are Patient Views about Antibiotics Related to Clinician Perceptions, Management and Outcome? A Multi-Country Study in Outpatients with Acute Cough. *PLoS ONE*, *8*(10), 1–9. https://doi.org/10.1371/journal.pone.0076691

Cornick, J. E., & Bentley, S. D. (2012). Streptococcus pneumoniae: The evolution of antimicrobial resistance to beta-lactams, fluoroquinolones and macrolides. *Microbes and Infection*. https://doi.org/10.1016/j.micinf.2012.01.012

Czekalski Nadine, Elena Gascón Díez, and H. B. (2014). Wastewater as a point source of antibioticresistance genes in the sediment of a freshwater lake. Retrieved from https://www.nature.com/ismej/journal/v8/n7/pdf/ismej20148a.pdf

Davies, J., & Davies, D. (2010). Origins and Evolution of Antibiotic Resistance. *Microbiology and Molecular Biology Reviews*. https://doi.org/10.1128/MMBR.00016-10

Diniz-Santos Av Princesa, D. R., Diniz-Santos, D. R., Silva, L. R., & Silva, N. (2006). Antibiotics for the Empirical Treatment of Acute Infectious Diarrhea in Children. *BJID*

The Brazilian Journal of Infectious Diseases, *1010*(2173), 217–227. Retrieved from www.bjid.com.br

Dondorp, A. M., Limmathurotsakul, D., & Ashley, E. A. (2017). What's wrong in the control of antimicrobial resistance in critically ill patients from low- and middle-income countries? *Intensive Care Medicine*, 1–4. https://doi.org/10.1007/s00134-017-4795-z

Dooling, K., Kandeel, A., Hicks, L., El-Shoubary, W., Fawzi, K., Kandeel, Y., … Talaat, M. (2014). Understanding Antibiotic Use in Minya District, Egypt: Physician and Pharmacist Prescribing and the Factors Influencing Their Practices. *Antibiotics*, *3*(2), 233–243. https://doi.org/10.3390/antibiotics3020233

Durai, R., Ng, P. C. H., Hoque, H., Wahner-Roedler, D. L., Vandell, A. G., & Howe, C. L. (2010). Methicillin-resistant Staphylococcus aureus: an update. *AORN Journal*, *91*(5), 599-606–9. https://doi.org/10.1016/j.aorn.2009.11.065

Ekwochi, U., Chinawa, J. M., Obi, I., Obu, H. A., & Agwu, S. (2013). Use and/or misuse of antibiotics in management of diarrhea among children in enugu, Southeast Nigeria. *Journal of Tropical Pediatrics*. https://doi.org/10.1093/tropej/fmt016

El Ezz, N., & Ez-Elarab, H. (2011). Knowledge, attitude and practice of medical students towards self medication at Ain Shams University, Egypt. *Journal of Preventive Medicine and Hygiene*, *52*(4). https://doi.org/10.15167/2421-4248/jpmh2011.52.4.292

El Kholy, A., Baseem, H., Hall, G. S., Procop, G. W., & Longworth, D. L. (2003). Antimicrobial resistance in Cairo, Egypt 1999-2000: a survey of five hospitals. *Journal of Antimicrobial Chemotherapy*, *51*(3), 625–630. https://doi.org/10.1093/jac/dkg101

Elgharably, A., Gomaa, A. I., Crossey, M. M., Norsworthy, P. J., Waked, I., & Taylor-Robinson, S. D. (2017). Hepatitis C in Egypt - past, present, and future. *International Journal of General Medicine*, *10*, 1–6. https://doi.org/10.2147/IJGM.S119301

El-Gilany, a, El-Wehady, a, & El-Wasify, M. (2012). Updating and validation of the socioeconomic status scale for health research in Egypt. *Eastern Mediterranean Health Journal = La Revue de Santé de La Méditerranée Orientale = Al-Majallah Al-Ṣiḥḥīyah Li-Sharq Al-Mutawassiṭ*, *18*(9), 962–8. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/23057390

El-Gilany, A. H., & Hammad, S. (2005). Epidemiology of diarrhoeal diseases among children under age 5 years in Dakahlia, Egypt. *Eastern Mediterranean Health Journal*, *11*(4), 4–762. Retrieve from https://www.ncbi.nlm.nih.gov/pubmed/16700393

Elhassan, S. M., Elhassan, G. O., Alfadl, A. A., Sirelkhatim, S. A., & Alfarouk, K. O. (2016). Evaluation of Drug Affordability in Khartoum State, Sudan. Pharmacovigilance, 4(1), 2329-6887.

El-Hawy Raghda M, Ashmawy Mohamed I, Kamal Menna M, A Khamis Hager, Abo El-Hamed Naglaa M, Eladely Gehad I, … Hamdy Dalia A. (2017). Studying the knowledge, attitude and practice of antibiotic misuse among Alexandria population. *Eur J Hosp Pharm* , 349–354. Retrieved from http://ejhp.bmj.com/content/24/6/349

Elhoseeny, T. A., & Mourad, J. K. (2014). Assessment of the safety of injection practices and injection-related procedures in family health units and centers in Alexandria. *Journal of the Egyptian Public Health Association*, *89*(2), 66–73. https://doi.org/10.1097/01.EPX.0000445305.88786.9e

Elhoseeny, T. A., Ibrahem, S. Z., & Abo El Ela, A. M. (2013). Opinion of community pharmacists on use of nonprescription medications in Alexandria , Egypt. *Journal of the Egyptian Public Health Association J Egypt Public Health Assoc Egyptian Public Health Association*, *88*(88), 79–84. https://doi.org/10.1097/01.EPX.0000430954.20897.2d

El-Nimr, N. A., Wahdan, I. M. H., Wahdan, A. M. H., & Kotb, R. E. (2015). Self-medication with drugs and complementary and alternative medicines in Alexandria, Egypt: prevalence, patterns and determinants. Eastern *Mediterranean Health Journal*. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/26077520

El-Teheawy, M. M., el-Bokl, M. A., Abd el-Fattah, S. A., & Sabbour, M. S. (1988). The pattern of antimicrobial use in general hospitals in Egypt. *Chemioterapia : International Journal of the Mediterranean Society of Chemotherapy*, *7*(6), 387–92. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/3219750

Eser, F. (2017). Carbapenem resistant Enterobacteriaceae. *Infectious Diseases and Microbiology*. https://doi.org/10.5505/ias.2017.15045

European Antimicrobial Resistance Surveillance Network (EARS-Net) (2017) Antimicrobial resistance surveillance in Europe. *European Centre for Disease Prevention and Control CDC*. Retrieved from https://ecdc.europa.eu/sites/portal/files/media/en/publications/Publications/antimicrobial-resistance-europe-2015.pdf

Fadel, R., Dakdouki, G. K., Kanafani, Z. A., Araj, G. F., & Kanj, S. S. (2004). Clinical and Microbiological Profile of Urinary Tract Infection at a Tertiary-Care Center in Lebanon. *Infection Control & Hospital Epidemiology*, *25*(1), 82–85. https://doi.org/10.1086/502298

Farah, R., Lahoud, N., Salameh, P., & Saleh, N. (2015). Antibiotic dispensation by Lebanese pharmacists: A comparison of higher and lower socio-economic levels. *Journal of Infection and Public Health*, *8*(1), 37–46. https://doi.org/10.1016/j.jiph.2014.07.003

Farid, S. F., Sabry, N. A., & Aziz 11, E. O. A. (2009). Role of the Pharmacist in Identification of Medication Related Problems in the ICU: A Preliminary Screening

Study in an Egyptian Teaching Hospital. *Australian Journal of Basic and Applied Sciences*, *3*(2), 995–1003. Retrieved from https://files.zotero.net/5090851288/Role_of_the_Pharmacist_in_Identification_of_Medica.pdf

Fernandes, M., Leite, A., Basto, M., Nobre, M. A., Vieira, N., Fernandes, R., … Jorge, P. (2014). Non-adherence to antibiotic therapy in patients visiting community pharmacies. *International Journal of Clinical Pharmacy*, *36*(1), 86–91. https://doi.org/10.1007/s11096-013-9850-4

Fletcher, S. M., McLaws, M.-L., & Ellis, J. T. (2013). Prevalence of gastrointestinal pathogens in developed and developing countries: systematic review and meta-analysis. *Journal of Public Health Research*, *2*(1), 42–53. https://doi.org/10.4081/jphr.2013.e9

Ganguly, N. K. (2011). SITUATION ANALYSIS Antibiotic Use and Resistance in India Global Antibiotic Resistance Partnership-India National Working Group. Retrieved from https://www.cddep.org/wp-content/uploads/2017/08/garp-india_sa.pdf.

Goossens, H., Ferech, M., Stichele, Vander R, Elseviers M; ESAC Project Group. (2005). Introduction Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. *Www.Thelancet.Com*, *365*(12), 579–587. https://doi.org/10.1016/S0140-6736(05)17907-0

Gould, I. M., & Bal, A. M. (2013). New antibiotic agents in the pipeline and how they can help overcome microbial resistance. *Virulence*. https://doi.org/10.4161/viru.22507

Grigoryan, L., Haaijer-Ruskamp, F. M., Burgerhof, J. G. M., Mechtler, R., Deschepper, R., Tambic-Andrasevic, A., Birkin, J. (2006). Self-medication with antimicrobial drugs in Europe. *Emerging Infectious Diseases*, *12*(3), 452–459. https://doi.org/10.3201/eid1205.050992

Habibzadeh, F. (2012). Antibiotic misuse and antibiotic-resistant bacteria. Editor's Page. Vol 379.

Hadi, M. A., Karami, N. A., Al-Muwalid, A. S., Al-Otabi, A., Al-Subahi, E., Bamomen, A., … Elrggal, M. E. (2016). Community pharmacists' knowledge, attitude, and practices towards dispensing antibiotics without prescription (DAwP): A cross-sectional survey in Makkah Province, Saudi Arabia. *International Journal of Infectious Diseases*. https://doi.org/10.1016/j.ijid.2016.06.003

Hammoud, M. S., Al-Taiar, A., Al-Abdi, S. Y., Bozaid, H., Khan, A., AlMuhairi, L. M., & Rehman, M. U. (2017). Late-onset neonatal sepsis in Arab states in the Gulf region: two-year prospective study. *International Journal of Infectious Diseases*, *55*, 125–130. https://doi.org/10.1016/J.IJID.2017.01.006

Harrison, E. M., Paterson, G. K., Holden, M. T. G., Larsen, J., Stegger, M., Larsen, A. R., … Holmes, M. A. (2013). Whole genome sequencing identifies zoonotic transmission of MRSA isolates with the novel mecA homologue mecC. *EMBO Molecular Medicine*, *5*(4), 509–15. https://doi.org/10.1002/emmm.201202413

Heidarifar R, Koohbor M, Kazemian Mansourabad M, et al. (2013). Self-medication with Antibiotics among Iranian Population in Qom State. *Journal of Scientific and Innovative Research.*; 2 (4): 785-789.

Hellen Gelband, Molly Miller-Petrie, Suraj Pant, Sumanth Gandra, Jordan Levinson, Devra Barter, Andrea White, R. L. (2015). The State of the World's Antibiotics 2015. *Wound Healing South Africa*, *8*. Retrieved from http://journals.co.za/docserver/fulltext/mp_whsa/8/2/mp_whsa_v8_n2_a4.pdf?expires=1511554094&id=id&accname=guest&checksum=87BEBD4E1FF78B14E3BF7C68C702E987

High income - Sweden (2017). The World Bank. Retrieved from https://data.worldbank.org/income-level/high-income

Hughes, D. (2014). Selection and evolution of resistance to antimicrobial drugs. *IUBMB Life*, *66*(8), 521–529. https://doi.org/10.1002/iub.1278

Ibrahim, OM., & Saber-Ayad, M. (2012). ANTIBIOTICS MISUSE IN DIFFERENT HOSPITAL WARDS (A PILOT STUDY IN AN EGYPTIAN HOSPITAL). *Asian Journal of Pharmaceutical and Clinical Research*, *5*(2). Retrieved from http://www.ajpcr.com/Vol5Issue2/841.pdf

Jamal, W. Y., & Rotimi, V. O. (2016). Surveillance of Antibiotic Resistance among Hospital- and Community-Acquired Toxigenic Clostridium difficile Isolates over 5-Year Period in Kuwait. *PLOS ONE*, *11*(8), e0161411. https://doi.org/10.1371/journal.pone.0161411

Jose, J., Jimmy, B., Mohammed Saif AlSabahi, A. G., & Al Sabei, G. A. (2013). A study assessing public knowledge, belief and behavior of antibiotic use in an Omani population. *Oman Medical Journal*, *28*(5), 324–330. https://doi.org/10.5001/omj.2013.95

Kandeel Amr, El-Shoubary Waleed, Hicks Lauri A., Abdel Fattah Mohamed, Dooling Kathleen L., Lohiniva Anna Leena, … Talaat Maha. (2014). Patient Attitudes and Beliefs and Provider Practices Regarding Antibiotic Use for Acute Respiratory Tract Infections in Minya, Egypt. *Antibiotics*, *3*(4), 632–644. https://doi.org/10.3390/antibiotics3040632

Kavanagh, K. T., Abusalem, S., & Calderon, L. E. (2017). The incidence of MRSA infections in the United States: is a more comprehensive tracking system needed? *Antimicrobial Resistance and Infection Control*, *6*, 34. https://doi.org/10.1186/s13756-017-0193-0

Khadr, Z., Nour el Dein, M., & Hamed, R. (2010). Using GIS in constructing area-based physical deprivation index in Cairo Governorate, Egypt. *Habitat International*, *34*(2), 264–272. https://doi.org/10.1016/j.habitatint.2009.11.001

Khalifeh, M. M., Moore, N. D., & Salameh, P. R. (2017). Self-medication misuse in the Middle East: a systematic literature review. *Pharmacology Research & Perspectives*, *5*(4), e00323. https://doi.org/10.1002/prp2.323

Khalil, H., Abdullah, W., Khawaja, N., Alsalem, A., Alharbi, S., Salleeh, H. Bin, & Shah, A. H. (2013). Self-prescribed antibiotics by Saudi patients as a routine self-management of dental problems. *Life Science Journal Life Sci J*, *1010*(44). Retrieved from http://www.lifesciencesite.com

Khalil, R. B. (2012). PRM58 Turning the Implausible to the Plausible: Towards a Better Control of Over the Counter Dispensing of Antibiotics in Egypt. *Value in Health*, *15*(4), A169. https://doi.org/10.1016/j.jval.2012.03.913

Klevens, R. M., Morrison, M. A., Nadle, J., Petit, S., Gershman, K., Ray, S., … Investigators, for the A. B. C. surveillance (ABCs) M. (2007). Invasive Methicillin-Resistant <EMPH TYPE="ITAL">Staphylococcus aureus</EMPH> Infections in the United States. *JAMA*, *298*(15), 1763. https://doi.org/10.1001/jama.298.15.1763

LaMorte, W. W. (2016). Cohort Studies and Case-Control Studies _ Outbreak Investigations. Retrieved December 15, 2017, from http://sphweb.bumc.bu.edu/otlt/mph-modules/ph/outbreak/Outbreak7.html

Laxminarayan, R., & Heymann, D. (2012). Challenges of drug resistance in the developing world. *Source BMJ: British Medical Journal*, *344*(7852), 25–27. Retrieved from http://www.jstor.org/stable/41551778

Laxminarayan, R., Duse, A., Wattal, C., Zaidi, A. K. M., Wertheim, H. F. L., Sumpradit, N., … Cars, O. (2013). Antibiotic resistance-the need for global solutions. *The Lancet Infectious Diseases*. https://doi.org/10.1016/S1473-3099(13)70318-9

Levy, S. (2014). Reduced antibiotic use in livestock: how Denmark tackled resistance. *Environmental Health Perspectives*, *122*(6), A160-5. https://doi.org/10.1289/ehp.122-A160

Lim, C., Takahashi, E., Hongsuwan, M., Wuthiekanun, V., Thamlikitkul, V., Hinjoy, S., … Limmathurotsakul, D. (2016). Epidemiology and burden of multidrug-resistant bacterial infection in a developing country. *eLife*, *5*. https://doi.org/10.7554/eLife.18082

Lin, S., Sun, M., Fitzgerald, E., & Hwang, S. (2016). Did summer weather factors affect gastrointestinal infection hospitalizations in New York State? Science of The Total Environment, 550, 38-44. Retrieved from https://www.sciencedirect.com/science/article/pii/S0048969715313085?via=ihub.

Llor, C., & Bjerrum, L. (2014). Antimicrobial resistance: risk associated with antibiotic overuse and initiatives to reduce the problem. *Therapeutic Advances in Drug Safety*, *5*(6), 229–241. https://doi.org/10.1177/2042098614554919

Lobanovska, M., & Pilla, G. (2017). Penicillin's Discovery and Antibiotic Resistance: Lessons for the Future? *Yale J Biol Med.*, *90*(1), 135–145. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/28356901

Lutgring, J. D., & Limbago, B. M. (2016). The Problem of Carbapenemase-Producing-Carbapenem-Resistant-Enterobacteriaceae Detection. *Journal of Clinical Microbiology*, *54*(3), 529–34. https://doi.org/10.1128/JCM.02771-15

McNulty, C. A. M., Boyle, P., Nichols, T., Clappison, P., & Davey, P. (2007). Don't wear me out - The public's knowledge of and attitudes to antibiotic use. *Journal of Antimicrobial Chemotherapy*, *59*(4), 727–738. https://doi.org/10.1093/jac/dkl558

Methicillin-resistant Staphylococcus aureus (MRSA) Infections | MRSA | Centers for Disease Control CDC. (2016) Retrieved July 22, 2017, from https://www.cdc.gov/mrsa/

Meyer, W. G., Pavlin, J. A., Hospenthal, D., Murray, C. K., Jerke, K., Hawksworth, A., … Lindler, L. (2011). Antimicrobial resistance surveillance in the AFHSC-GEIS network. Retrieved from https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-11-S2-S8

Moini, A. S., Soltani, B., Ardakani, A. T., Moravveji, A., Erami, M., Rezaei, M. H., & Namazi, M. (2015). Multidrug-Resistant Escherichia coli and Klebsiella pneumoniae Isolated From Patients in Kashan, Iran, *8*(10). https://doi.org/10.5812/jjm.27517

Moise, K., Bernard, J. J., & Henrys, J. H. (2017). Evaluation of antibiotic self-medication among outpatients of the state university hospital of Port-au-Prince, Haiti: a cross-sectional study. *The Pan African Medical Journal*, *28*, 4. https://doi.org/10.11604/pamj.2017.28.4.12589

Molly Miller-Petrie, M., & Gelband, H. (2017). Socioeconomics, antimicrobial use and antimicrobial resistance _ AMR Control. Retrieved from http://resistancecontrol.info/2017/socioeconomics-antimicrobial-use-and-antimicrobial-resistance/

Mouhieddine, T. H., Olleik, Z., Itani, M. M., Kawtharani, S., Nassar, H., Hassoun, R., … Tamim, H. (2015). Assessing the Lebanese population for their knowledge, attitudes and practices of antibiotic usage. *Journal of Infection and Public Health*, *8*(1), 20–31. https://doi.org/10.1016/j.jiph.2014.07.010

Napolitano, F., Izzo, M. T., Di Giuseppe, G., & Angelillo, I. F. (2013). Public knowledge, attitudes, and experience regarding the use of antibiotics in Italy. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0084177

Ocan, M., Obuku, E. A., Bwanga, F., Akena, D., Richard, S., Ogwal-Okeng, J., … Munoz, M. (2015). Household antimicrobial self-medication: a systematic review and meta-analysis of the burden, risk factors and outcomes in developing countries. *BMC Public Health*, *15*(1), 742. https://doi.org/10.1186/s12889-015-2109-3

Okeke, I. N. (2010). Poverty and Root Causes of Resistance in Developing Countries. In *Antimicrobial Resistance in Developing Countries* (pp. 27–35). New York, NY: Springer New York. https://doi.org/10.1007/978-0-387-89370-9_3

Okeke, I. N., Laxminarayan, R., Bhutta, Z. A., Duse, A. G., Jenkins, P., O'Brien, T. F., … Klugman, K. P. (2005). Antimicrobial resistance in developing countries. Part I: recent trends and current status. *The Lancet Infectious Diseases*, *5*(8), 481–493. https://doi.org/10.1016/S1473-3099(05)70189-4

Pai, M., Daftary, A., & Satyanarayana, S. (n.d.). TB control: challenges and opportunities for India. https://doi.org/10.1093/trstmh/trw003

Pavydė, E., Veikutis, V., Mačiulienė, A., Mačiulis, V., Petrikonis, K., & Stankevičius, E. (2015). Public knowledge, beliefs and behavior on antibiotic use and self-medication in Lithuania. *International Journal of Environmental Research and Public Health*, *12*(6), 7002–7016. https://doi.org/10.3390/ijerph120607002

Prestinaci, F., Pezzotti, P., & Pantosti, A. (2015). Antimicrobial resistance: a global multifaceted phenomenon. *Pathogens and Global Health*, *109*(7), 309–18. https://doi.org/10.1179/2047773215Y.0000000030

Reardon, S. (2014). Antibiotic resistance sweeping developing world: bacteria are increasingly dodging extermination as drug availability outpaces regulation. *Nature*, *509*(7499), 141–143. Retrieved from http://go.galegroup.com/ps/anonymous?id=GALE%7CA367642718&sid=googleScholar&v=2.1&it=r&linkaccess=fulltext&issn=00280836&p=AONE&sw=w&authCount=1&isAnonymousEntry=true

Regional Health System Observatory – EMRO, WHO. *Health System Profile - Egypt (Rep.)* (2006). Cairo. Retrived from http://apps.who.int/medicinedocs/documents/s17293e/s17293e.pdf

Rezaie, A., Nikfar, S., & Abdollahi, M. The place of antibiotics in management of irritable bowel syndrome: A systematic review and meta-analysis, 6 Archives of Medical Science § (2010). Termedia Publishing. https://doi.org/10.5114/aoms.2010.13507

Roberts, R., Hota, B., Ahmad, I., Scott II, R. Dougla., Foster, S., Abbasi, F., … Weinstein, R. (2009). Hospital and Societal Costs of Antimicrobial?Resistant Infections in a Chicago Teaching Hospital: Implications for Antibiotic Stewardship. *Clinical Infectious Diseases*, *49*(8), 1175–1184. https://doi.org/10.1086/605630

Roca, I., Akova, M., Baquero, F., Carlet, J., Cavaleri, M., Coenen, S., … Vila, J. (2015). The global threat of antimicrobial resistance science for intervention. *New Microbes and New Infections*, *6*, 22–9. https://doi.org/10.1016/j.nmni.2015.02.007

Rosenthal, V. D., Maki, D. G., Mehta, Y., Leblebicioglu, H., Memish, Z. A., Al-Mousa, H. H., … Anh, D. P. P. (2014). International Nosocomial Infection Control Consortium (INICC) report, data summary of 43 countries for 2007-2012. Device-associated module. *American Journal of Infection Control*, *42*(9), 942–56. https://doi.org/10.1016/j.ajic.2014.05.029

Sabry, N. A., Farid, S. F., & Dawoud, D. M. (2014). Antibiotic dispensing in Egyptian community pharmacies: An observational study. *Research in Social and Administrative Pharmacy*, *10*(1), 168–184. https://doi.org/10.1016/j.sapharm.2013.03.004

Saied, T., Elkholy, A., Hafez, S. F., Basim, H., Wasfy, M. O., El-Shoubary, W., … Talaat, M. (2011). Antimicrobial resistance in pathogens causing nosocomial bloodstream infections in university hospitals in Egypt. *American Journal of Infection Control*, *39*(9), e61–e65. https://doi.org/10.1016/J.AJIC.2011.04.009

Sallam, S. A., Khallafallah, N. M., Ibrahim1, N. K., & Okasha1, A. O. (2009). ٣، ٢٠٠٩
المجلة الصحية لشرق المتوسط، منظمة الصحة العالمية، المجلد الخامس عشر، العدد
Pharmacoepidemiological study of self-medication in adults attending pharmacies in Alexandria, Egypt. *Eastern Mediterranean Health Journal*, *15*(3). Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/19731784

Sapkota, A. R., Coker, M. E., Rosenberg Goldstein, R. E., Atkinson, N. L., Sweet, S. J., Sopeju, P. O., … Ojo, K. K. (2010). Self-medication with antibiotics for the treatment of menstrual symptoms in southwest Nigeria: a cross-sectional study. *BMC Public Health*. https://doi.org/10.1186/1471-2458-10-610

Sawair, F. A., Baqain, Z. H., Abu Karaky, A., & Abu Eid, R. (2009). Assessment of self-medication of antibiotics in a Jordanian population. *Medical Principles and Practice*, *18*(1), 21–25. https://doi.org/10.1159/000163041

Shallcross, L. J., & Davies, D. S. C. (2014). Antibiotic overuse: a key driver of antimicrobial resistance. *The British Journal of General Practice : The Journal of the*

Royal College of General Practitioners, *64*(629), 604–5. https://doi.org/10.3399/bjgp14X682561

Shehadeh, M. B., Suaifan, G. A. R. Y., & Hammad, E. A. (2016). Active educational intervention as a tool to improve safe and appropriate use of antibiotics. *Saudi Pharmaceutical Journal*, *24*(5), 611–615. https://doi.org/10.1016/J.JSPS.2015.03.025

Shehadeh, M., Suaifan, G., Darwish, R. M., Wazaify, M., Zaru, L., & Alja'fari, S. (2012). Knowledge, attitudes and behavior regarding antibiotics use and misuse among adults in the community of Jordan. A pilot study. *Saudi Pharmaceutical Journal*, *20*(2), 125–133. https://doi.org/10.1016/j.jsps.2011.11.005

Shibl, A., Memish, Z., & Pelton, S. (2009). Epidemiology of invasive pneumococcal disease in the Arabian Peninsula and Egypt. *International Journal of Antimicrobial Agents, 33*(5), 410.e1-410.e9. https://doi.org/10.1016/j.ijantimicag.2008.08.012.

Sims David (2012). Understanding Cairo: The Logic of a City out of Control. Cairo and New York: The American University in Cairo Press.

Singh, V. (2013). Antimicrobial Resistance. *Microbial Pathogens and Strategies for Combating Them: Science, Technology and Education*. Retrieved from http://www.formatex.info/microbiology4/vol1/291-296.pdf

Spellberg, B., Guidos, R., Gilbert, D., Bradley, J., Boucher, H. W., Scheld, W. M., … Edwards Jr., J. (2008). The Epidemic of Antibiotic-Resistant Infections: A Call to Action for the Medical Community from the Infectious Diseases Society of America. *Clinical Infectious Diseases*, *46*(1537–6591 (Electronic)), 155–164. https://doi.org/10.1086/524891

Tadesse, B. T., Ashley, E. A., Ongarello, S., Havumaki, J., Wijegoonewardena, M., González, I. J., & Dittrich, S. (2017). Antimicrobial resistance in Africa: a systematic review. *BMC Infectious Diseases*, *17*(1), 616. https://doi.org/10.1186/s12879-017-2713-1

Talaat, M., El-Shokry, M., El-Kholy, J., Ismail, G., Kotb, S., Hafez, S., … Lessa, F. C. (2016). National surveillance of health care???associated infections in Egypt: Developing a sustainable program in a resource-limited country. *American Journal of Infection Control*. https://doi.org/10.1016/j.ajic.2016.04.212

Talaat, M., Kandeel, A., Rasslan, O., Hajjeh, R., Hallaj, Z., El-Sayed, N., & Mahoney, F. J. (2006). Evolution of infection control in Egypt: Achievements and challenges. *American Journal of Infection Control*. https://doi.org/10.1016/j.ajic.2005.05.028

Talaat, M., Saied, T., Kandeel, A., El-Ata, G., El-Kholy, A., Hafez, S., … Com, A. (2014). A Point Prevalence Survey of Antibiotic Use in 18 Hospitals in Egypt. *Antibiotics*, *3*(3), 450–460. https://doi.org/10.3390/antibiotics3030450

Tello, A., Austin, B., & Telfer, T. C. (2012). Selective Pressure of Antibiotic Pollution on Bacteria of Importance to Public Health. *Environmental Health Perspectives*, *120*(8), 1100–1106. https://doi.org/10.1289/ehp.1104650

The bacterial challenge: time to react (2009) *European Centre for Disease Prevention and Control CDC*. Retrieved from https://ecdc.europa.eu/en/news-events/bacterial-challenge-time-react-0

Thelle, D. S., & Laake, P. (2015). Epidemiology. In *Research in Medical and Biological Sciences* (pp. 275–320). Elsevier. https://doi.org/10.1016/B978-0-12-799943-2.00009-4

Udo, E. E., Boswihi, S. S., & Pract, M. P. (2017). Antibiotic Resistance Trends in Methicillin-Resistant Staphylococcus aureus Isolated in Kuwait Hospitals: 2011–2015 Udo/Boswihi. https://doi.org/10.1159/000481944

UN Habitat. (2008). Expert meeting on Slum Identification Mapping and Monitoring. Retrieved December 15, 2017, from https://www.itc.nl/Pub/News/News-News-2008/News-News-2008-May/Expert_meeting_Slum_Identification.html

United Nations World Population Prospects UN WPP (2017). Population growth (annual %) Egypt. Retrieved from https://data.worldbank.org/indicator/SP.POP.GROW?locations=EG

Van Boeckel, T. P., Gandra, S., Ashok, A., Caudron, Q., Grenfell, B. T., Levin, S. A., & Laxminarayan, R. (2014). Global antibiotic consumption 2000 to 2010: an analysis of national pharmaceutical sales data. *The Lancet. Infectious Diseases*, *14*(8), 742–750. https://doi.org/10.1016/S1473-3099(14)70780-7

Van Hoek, A. H. A. M., Mevius, D., Guerra, B., Mullany, P., Roberts, A. P., & Aarts, H. J. M. (2011). Acquired antibiotic resistance genes: an overview. *Frontiers in Microbiology*, *2*, 203. https://doi.org/10.3389/fmicb.2011.00203

Versporten, A., Bolokhovets, G., Ghazaryan, L., Abilova, V., Pyshnik, G., Spasojevic, T., … Goossens, H. (2014). Antibiotic use in eastern Europe: A cross-national database study in coordination with the WHO Regional Office for Europe. *The Lancet Infectious Diseases*, *14*(5), 381–387. https://doi.org/10.1016/S1473-3099(14)70071-4

Vuotto, C., Longo, F., Balice, M., Donelli, G., & Varaldo, P. (2014). Antibiotic Resistance Related to Biofilm Formation in Klebsiella pneumoniae. *Pathogens*. https://doi.org/10.3390/pathogens3030743

Wagdy, S. (2016). Anti-Microbial Resistance (AMR) Update and Control Strategy in Egypt (Egypt, Ministry of Health, Preventive Sector). https://au.int/sites/default/files/documents/32387-doc-4._amr_update_and_control_strategy_in_egypt.pdf

WHO. (2012). WHO | The WHO policy package to combat antimicrobial resistance. *WHO*. Retrieved from http://www.who.int/bulletin/volumes/89/5/11-088435/en/

Yilmaz, N., Agus, N., Yurtsever, S. G., Pullukcu, H., Gulay, Z., Coskuner, A., … Ozgenc, O. (2009). Prevalence and antimicrobial susceptibility of Escherichia coli in outpatient urinary isolates in Izmir, Turkey. *Medical Science Monitor : International Medical Journal of Experimental and Clinical Research*, *15*(11), PI61-5. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/19865064

Zenati, K., Sahli, F., Garcia, V., Bakour, S., Belhadi, D., Rolain, J. M., & Touati, A. (2017). Occurrence and clonal diversity of multidrug-resistant Klebsiella pneumoniae recovered from inanimate surfaces in Algerian hospital environment: First report of armA, qnrB and aac(6′)-Ib-cr genes. *Journal of Global Antimicrobial Resistance*, *10*, 148–153. https://doi.org/10.1016/J.JGAR.2017.05.015

Zyoud, S. H., Abu Taha, A., Araj, K. F., Abahri, I. A., Sawalha, A. F., Sweileh, W. M., … Al-Jabi, S. W. (2015). Parental knowledge, attitudes and practices regarding antibiotic use for acute upper respiratory tract infections in children: a cross-sectional study in Palestine. *BMC Pediatrics*, *15*(1), 176. https://doi.org/10.1186/s12887-015-0494-5

APPENDIX A

Questionnaire from Sawair et al., 2009

Please answer the following questions:

1. Age ……… (years)
2. Gender: M F
3. Marital status: Single Married Divorced Widowed
4. Level of education:

- No formal education - Primary School - Secondary school

- High School - University degree - Postgraduate

5. Employment situation:

-Working -Retired -Unemployed

-Housewife -Student

6. Household monthly income:

- < 100 JDs - 100-200 JDs - 200-300 JDs

- 300-400 JDs - 400-500 JDs - > 500 JDs

7. Self-reported health:

- Good - Intermediate - Poor

8. Chronic Morbidity:

- Yes - No Disease/s; ----------------------------

9. Medical Insurance:

- Yes (100% covered) - Yes (80-90% covered) - Yes (50-70% covered)

- No

10. Smoking:

- Yes - No - Ex-smoker

11. Had you taken antibiotics in the last 6 months without consulting a physician?

- Yes - No

12. If yes, please specify why you had taken the antibiotics **the last time**?

- Common cold
- Cough
- Fever
- Sore throat
- Earache
- Painful urination
- Abdominal pain
- Diarrhea
- Toothache (dental Infections)
- Rash, dermatological problems
- Headache
- Others, please

specify:____

13. The source of the antibiotic:

- Directly from private pharmacy
- Relatives and friends
- Left over drugs from previous treatment

14. Which antibiotic you had taken:

- Penicillin
- Amoxicillin
- Metronidazole
- Cephalosporins
- Erythromycin
- Clindamycin
- Lincomycin
- Others, ____

15. Dose, frequency and duration of the antibiotic taken compared to recommended guidelines:

- Correct
- Incorrect

16. Reasons for self-medication:

- Cost, because of no insurance
- Easier and less time consuming
- Previous experience with similar illness
- Hate visiting doctors
- No doctors nearby
- Others, ____

17. Had you ever gone to another physician to obtain antibiotics when the first physician you saw did not prescribe antibiotics? Yes No

APPENDIX B

Questionnaire in Arabic

إستمارة　　　　　　　　**رقم الاستمارة:**

موافقة مسبقة للمشاركة في دراسة بحثية

عنوان البحث : أسباب إستخدام المضادات الحيوية في القاهرة

الباحث الرئيسي: شيماء محمد حسن - **الهاتف**: 01221879619 - **البريد الالكتروني**: shyma2a@aucegypt.edu

- **السرية واحترام الخصوصية**: ستكون هويتك سرية. - ان المشاركة فى هذه الدراسة ماهى الا عمل تطوعى, حيث أن الامتناع عن المشاركة لايتضمن أى عقوبات أو فقدان أى مزايا تحق لك. ويمكنك أيضا التوقف عن المشاركة فى أى وقت من دون عقوبة أو فقدان لهذه المزايا. لا يوجد أي مخاطر ولا يوجد إستفادة متوقعة من المشاركة بهذا البحث.

ملحوظة: المطهرات المعوية مثل(الأنتينال وفلاجيل و ضياكس وأمريزول و سيبرودیازول) يعتبروا مضادات حيوية

م	الأسئلة ومحدداتها	الكود الخاص بالإجابة		انتقل إلي
1	محل الإقامة			
2	العمر بالسنوات الكاملة؟	العمر بالسنوات الكاملة..[___|___]		
3	نوع المستجيب؟	ذكر	1	
		انثى	2	
4	الحالة الاجتماعية	أعزب / عازبة	1	
		متزوج/متزوجة	2	
		مطلق/مطلقة	3	
		أرمل/ارملة	4	
5	هل لديك اطفال	نعم	1	
		لا	2	7
6	عدد الاطفال؟	عدد الاطفال ....[___|___]		
7	مستوى التعليم	لا يوجد تعليم رسمي	1	
		شهادة ابتدائية	2	
		شهادة اعدادية	3	
		شهادة ثانوية	4	
		شهادة جامعية	5	
		دراسات عليا	6	
8	الحالة الوظيفية	يعمل	1	
		متقاعد	2	10
		عاطل عن العمل	3	10
		ربة منزل	4	10
		طالب / طالبة	5	10
9	ما هي وظيفتك؟			
10	الدخل الشهري للاسرة (بالجنيه المصري)؟	اقل من 1500	1	

م	الأسئلة ومحدداتها	الكود الخاص بالإجابة		انتقل إلي
		1500 - 4000	2	
		4001 - 6000	3	
		6001 - 8000	4	
		8001 - 10000	5	
		10001 - 12000	**6**	
		أكثر من 12000	**7**	
11	كيف ترى حالتك الصحية	جيدة	1	
		متوسطة	2	
		ضعيفة	3	
12	هل لديك أي مشكلة صحية مزمنة؟ زي السكر أو غدة/ قلب/ كوليستيرول	نعم	1	
		لا	2	**14**
13	ما هي مشكلةالصحية/ المرض المزمن؟			
14	هل لديك تأمين صحي؟	نعم	1	
		لا	2	**16**
15	ما هو نوع تغطية التأمين الصحي التي لديك؟	تغطية شاملة 100%	1	
		تغطية 80-90%	2	
		تغطية 50-70%	3	
		أقل من 50 %	4	
		لا أعرف	5	
16	هل تدخن:	نعم	1	
		لا	2	
		مدخن سابق	3	
17	هل أخدت (تناولت) أي مضادات حيوية خلال الستة أشهر الماضية؟	نعم	1	**20**
		لا	2	
18	هل أخد أحد أطفالك أو أحد أفراد أسرتك مضادات حيوية خلال الستة أشهر الماضية؟	نعم	1	
		لا	2	**26**
19	إذا كانت الإجابة بنعم لأطفالك / أو أحد أفراد أسرتك؟ كم عمره/ عمرها؟	العمر بالسنوات **[___|___]**		
20	انت اللي قررت تأخد المضاد الحيوي بنفسك؟ من غير روشتة؟ (أو تعطي المضاد الحيوي لأطفالك أو أحد أفراد أسرتك)	نعم	1	
		لا	2	**22**
21	أسباب شراء المضاد الحيوي من غير روشتة؟ ليه اخدته من نفسك؟ **(ليه اخدته من نفسك)**	تكلفة الدكتور	1	
		بسبب عدم وجود تأمين صحي	2	
		أقل استهلاكا للوقت من زيارة الدكتور	3	
		تجربة سابقة مع المرض/ أعراض مماثلة	4	
		كراهية زيارة الأطباء	5	
		لا يوجد أطباء قريبين أو وحدة صحية قريبة	6	
		أسباب أخرى	7	
22	مين اللي كتبلك المضاد الحيوي؟ او قالك تاخده	الدكتور المعالج	1	
		بنصيحة الصيدلي	2	
		بنصيحة من الأقارب والأصدقاء	3	
23	من فضلك اذكر أي من الأعراض التاليةجعلتك أنت أو أطفالك أو	نعم	لا	

م	الأسئلة ومحدداتها	الكود الخاص بالإجابة	انتقل إلي
	أحد افراد أسرتك التي تعتني به، تاخذ المضادات الحيوية في ال 6 شهور الماضية؟ **(الجواب يمكن أن يتضمن أكثر من أعراض)** **سؤال متعدد**	A. نزلات البرد .... 1 2 B. السعال / الكحة .... 1 2 C. حمى .... 1 2 D. التهاب الحلق .... 1 2 E. صداع .... 1 2 F. وجع الأذن .... 1 2 G. آلام أثناء التبول .... 1 2 H. الأسنان (التهابات الأسنان) .... 1 2 I. مشاكل في العين .... 1 2 J. طفح جلدي، مشاكل جلدية .... 1 2 K. الإسهال .... 1 2 L. امساك .... 1 2 M. مغص / وجع بطن .... 1 2 N. دم في البراز .... 1 2 O. انتفاخ .... 1 2 P. غثيان / الشعور بالقيء .... 1 2 Q. ألم شرجي .... 1 2 R. جفاف .... 1 2 S. أعراض أخرى، يرجى التحديد: 1 2	
24	هل أنت (أو أطفالك) أخذت جرعة المضاد الحيوي زي ما هيا مكتوبة في النشرة او تعليمات الدكتور (مثلا مرة كل 8 ساعات) ولا مش بالظبط (عن طريق توصية الصيدلي أو الطبيب أو نشرة الدواء)؟	نعم .... 1 لا 2	
25	هل أنت (أو أطفالك) التزمت بمدة ووقت المضاد الحيوي زي ما مكتوبالك (مثلا خلصت الاسبوع كله ولا لما اتحسنت بطلت بدري)	نعم .... 1 لا 2	
26	هل بتعالج المضادات الحيوية الفيروسات والبكتيريا ؟	نعم .... 1 لا .... 2 لا أعرف 3	
27	هل ذهبت إلى طبيب آخر للحصول على المضادات الحيوية عندما رفض أول طبيب أن يصف المضادات الحيوية؟	نعم .... 1 لا 2	

م	الأسئلة ومحدداتها	الكود الخاص بالإجابة	انتقل إلي
28	هل أخذت (أو أطفالك أو أحد أفراد اسرتك) دواء للإسهال في الأشهر ال 3 الماضية؟	نعم .... 1 لا 2	
29	هل أخذت (أو أطفالك أو أحد أفراد اسرتك) دواء للإمساك في الأشهر ال 3 الماضية؟	نعم .... 1 لا 2	
30	هل كان عندك (أو عند أطفالك أو أحد أفراد اسرتك) قرحة بالمعدة أو الإثني عشر من قبل؟	نعم .... 1 لا 2	
31	أي مضادات الحيوية أخذتها أنت (أو أطفالك أو أحد أفراد أسرتك التي تعتني به): يأخذ 1 لا يأخذ 2		

الكود	الاسم العلمي	الاسم التجاري		
0		لا أعرف	0	
1	بنسلين	ريتاربن حقن	1	
1	بنسلين	بنسيتارد حقن	2	
1	البنسلين + سولباكتام	يوناسن	3	
2	أموكسيبلين + كلافولانات	اوجمنتين	4	
2	أموكسيبلين + كلافولانات	هايبيوتيك	5	
2	أموكسيبلين + كلافولانات	ميجاموكس	6	
2	أموكسيبلين + حمض كلافولانيك	كيورام	7	
2	أموكسيبلين	أموكسيل 500 مليجرام / شراب	8	
2	أموكسيبلين	بيوموكس 500 مليجرام / شراب	9	
1+2	أموكسيبلين + فلكلوكساسيلين (بنسلين)	فلوموكس	10	
3	ميترونيدازول	فلاجيل 500أو250 مليجرام / شراب	11	
3	ميترونيدازول	أمريزول 500أو250 مليجرام / شراب	12	
3	سيبروفلوكساسين / ميترونيدازول	سيبروديازول	13	
4	نيفروكسازيد	أنتينال	14	
4	نيفروكسازيد	ضياكس	15	
5	سيبروفلوكساسين	سيبرو 500 مليجرام	16	
5	سيبروفلوكساسين	سيبروباي	17	
5	سيبروفلوكساسين	سيبروفار	18	
6	أزيثروميسين	زيثروماكس 250 مليجرام / شراب	19	
6	أزيثروميسين	زيثرون 500 مليجرام	20	
6	أزيثروميسين	زيثروكان 500 مليجرام	21	
7	كليندامايسين	دلاسين	22	
7	كليندامايسين	كلاسيد 500أو250 مليجرام / شراب	23	
7	كليندامايسين	كلاريماكس 500أو250 مليجرام	24	
7	لينكومايسين	لينكوسين 600أو300 مليجرام	25	
8	الأسيكلوفير (مضاد للفيروسات)	الأسيكلوفير	26	
8	الأسيكلوفير (مضاد للفيروسات)	زوفاريكس	27	

م	الأسئلة ومحدداتها		الكود الخاص بالإجابة			انتقل إلي
	8	الأسيكلوفير (مضاد للفيروسات)	لوفير	28		
	9	سيفالوسبورين	كيفليكس	29		
	9	سيفالوسبورين	سيفي بيم	30		
	10	سيفوتكسيم	سيفوتكس	31		
	10	سيفترياكسون	سيفترياكسون	32		
	11	كينولون	أوفلوكساسين	33		
	11	كينولون	ليفوفلوكساسين	34		
	11	كينولون	سيبروفلوكساسين	35		
	12	فلورو كينولون	فلوكسين	36		
	12	فلورو كينولون	ليفاكيون	37		
	13	تتراسيكلين	تتراسيكلين	38		
	13	تتراسيكلين	دوكسي سيكلين (فيبراميسين)	39		
	14	أمينوغليكوسيد	جنتاميسين (جاراميسين)	40		
	14	أمينوغليكوسيد	توبراميسين (توبريكس)	41		
	15	كوتريموكسازول	سيبترين	42		
		أخري				

APPENDIX C

Questionnaire in English

Reasons for Antibiotics use in Cairo

18. Place of residency

19. Age ……… (years)

20. Gender: M F

21. Marital status: Single Married Divorced Widowed

22. If married, do you had any children?

- Yes - No

23. Number of children

24. Level of education:

- No formal education - Primary School - Secondary school

- High School - University degree - Postgraduate

25. Employment situation:

-Working -Retired -Unemployed

-Housewife -Student

26. What is your job?

27. Household monthly income (EGP):

- < 1500 - <4000 - 4000 - 6000

- 6000 - 8000 - 8000 – 10,000 - 10,000 – 12,000

- > 12,000

28. Self-reported health:

- Good - Intermediate - Poor

29. Chronic Morbidity: (Do you had any longstanding illness or health problem?)

- Yes - No

30. If yes, what is the illness/ health problem?

31. Do you had health insurance?

- Yes - No

32. What is the type of health insurance coverage do you had?

- 100% covered - 80-90% covered - 50-70% covered

- Less than 50% - I do not know

33. Smoking:

- Yes - No - Ex-smoker

34. Had you taken any antibiotics in the last 6 months?

- Yes - No

35. Had any of your children or a family member that you take care of, took antibiotics in the last 6 month?

- Yes - No

36. If yes for your children or a family member that you take care of? How old is he/she? ……… (years)

37. Did you decide to take the antibiotics by yourself with no prescription?

- Yes - No

38. What are the reasons for self-medicating? Buying antibiotics without prescription?

- Cost of physician
- Because of no health insurance
- Less time consuming than doctor's visit
- Previous experience with similar illness
- Hate visiting doctors

- No doctors nearby or health units
- Others, ________

39. Who prescribed/told you to take the antibiotics?
- The physician
- With the advice of a pharmacist
- With the advice of relatives or friends

40. Please specify why you (or your children or a family member that you take care of) had taken antibiotics **in the last 6 month**? The answer can include more than one symptoms
- Common cold
- Cough
- Fever
- Sore throat
- Headache
- Ear pain
- Painful urination
- Toothache (dental Infections)
- Eye problems
- Rash, dermatological problems
- Diarrhoea
- Constipation
- Cramps / stomach ache
- Blood in stool
- Bloating
- Nausea
- Anal pain
- Dehydration
- Others, please

specify:____

41. Did you (or your children or a family member that you take care of) take the suggested **dose** of the antibiotics as recommended (Either by pharmacist, physician or leaflet of the drug) ?

- Yes - No

42. Did you (or your children or a family member that you take care of) stick to the duration and frequency of the antibiotics as recommended (Either by pharmacist, physician or leaflet of the drug?

43. Do Antibiotics treat viruses and bacteria?

- Yes - No

44. Had you ever gone to another physician to obtain antibiotics when the first physician you saw did not prescribe antibiotics?

- Yes - No

45. Had you (or your children or a family member that you take care of) taken laxatives in the last 3 months?

- Yes - No

46. Had you (or your children or a family member that you take care of) taken medicine for constipation in the last 3 month?

- Yes - No

47. Had you (or your children or a family member that you take care of) ever had a stomach (gastric) or duodenal ulcer?

- Yes - No

48. Which antibiotic you (or your children or a family member that you take care of) had taken:

Code	Generic Name	Brand Name	
0			0

1	Penicillin	Retarpen vial	1
1	Penicillin	Pencitard vial	2
1	Penicillin + Sulbactam	Unasyn	3
2	Amoxicillin + Clavulanate	Augmentin	4
2	Amoxicillin + Clavulanate	Hibiotic	5
2	Amoxicillin + Clavulanate	Megamox	6
2	Amoxycillin + Clavulanic acid	Curam	7
2	Amoxicillin	Amoxil 500 mg / Syrup	8
2	Amoxicillin	Biomox 500mg/ Syrup	9
1+2	Amoxicillin + Flucloxacillin (Penicillin)	Flumox	10
3	Metronidazole	Flagyl 500/250 + Syrup	11
3	Metronidazole	Amrizole 500/250 + Syrup	12
3	Ciprofloxacin/ Metronidazole	Ciprodiazole	13
4	Nifuroxazide	Antinal	14
4	Nifuroxazide	Diax	15
5	Ciprofloxacin	Cipro 500 mg	16
5	Ciprofloxacin	Ciprobay	17
5	Ciprofloxacin	Ciprofar	18
6	Azithromycin	Zithromax 250 mg + Syrup	19
6	Azithromycin	Xithrone 500 mg	20
6	Azithromycin	Zithrokan 500 mg	21
7	Clindamycin	Klacid 500/250 mg + Syrup	22

7	Clindamycin	Klarimax 500/250 mg	23
7	Clindamycin	Dalacin	24
7	Lincomycin	Lincocin 300/ 600 mg	25
8	Acyclovir (Antiviral)	Acyclovir	26
8	Acyclovir (Antiviral)	Zovarix	27
8	Acyclovir (Antiviral)	Lovir	28
9	Cephalosporins	Keflex	29
9	Cephalosporins	Cefepime	30
10	Cefotaxime	Cefotax	31
10	Ceftriaxone	Ceftriaxone	32
11	Quinolones	Ofloxacin	33
11	Quinolones	Levofloxacin	34
11	Quinolones	Ciprofloxacin	35
12	Fluoroquinolones	Floxin	36
12	Fluoroquinolones	Levaquin	37
13	Tetracyclines	Tetracycline	38
13	Tetracyclines	Doxycycline (Vibramycin)	39
14	Aminoglycosides	Gentamicin (Garamycin)	40
14	Aminoglycosides	Tobramycin (Tobrex)	41
15	Co-trimoxazole (Trimethoprim/sulfamethoxazole)	Septrin	42
	Others		

APPENDIX D

The consent form in Arabic

الجامعة الأمريكية بالقاهرة

استمارة موافقة مسبقة للمشاركة في دراسة بحثية

عنوان البحث : العوامل التي تؤثر علي العلاج الذاتي بالمضادات الحيوية في القاهرة

الباحث الرئيسي: شيماء محمد حسن سليمان
البريد الالكتروني: Shyma2a@aucegypt.edu
الهاتف: 01221879619

انت مدعو للمشاركة فى دراسة بحثية عن (العلاج الذاتي بالمضادات الحيوية).

هدف الدراسة هو
- هو تحديد العوامل التي تؤثر علي العلاج الذاتي بالمضادات الحيوية بمناطق مختلفة بالقاهرة.
- لا يوجد أي مخاطر أو مضايقات من المشاركة بهذا البحث. فهو عمل تطوعي وكل البيانات سوف تكون مجهولة المصدر
- لا يوجد إستفادة متوقعة من المشاركة بهذا البحث. و سوف يتم التخلص من البيانات بعد إنتهاء الدراسة.

السرية واحترام الخصوصية: ستكون هويتك سرية.

ان المشاركة فى هذه الدراسة ماهى الا عمل تطوعى, حيث أن الامتناع عن المشاركة لايتضمن أى عقوبات أو فقدان أى مزايا تحق لك. ويمكنك أيضا التوقف عن المشاركة فى أى وقت من دون عقوبة أو فقدان لهذه المزايا.

الامضاء: ....

اسم المشارك : ....

التاريخ : ..../................/.............

ملحوظة: المطهرات المعوية مثل الأنتينال وفلاجيل و ضياكس يعتبروا مضادات حيوية

APPENDIX E

Chi-Square test SMA with other variables

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
V20 Did you self-medicate with antibiotics * V7 Level of Education	576	71.8%	226	28.2%	802	100.0%

V20 Did you self-medicate with antibiotics * V7 Level of Education Crosstabulation

Count

		V7 Level of Education			Total
		1 No formal Education	2 Primary Education	3 Preparatory Education	
V20 Did you self-medicate with antibiotics	1 Yes	34	70	65	169
	2 No	20	116	271	407
Total		54	186	336	576

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	51.809[a]	2	.000
Likelihood Ratio	49.532	2	.000
Linear-by-Linear Association	51.164	1	.000
N of Valid Cases	576		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.84.

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
V20 Did you self-medicate with antibiotics * V1 Residency	576	71.8%	226	28.2%	802	100.0%

V20 Did you self-medicate with antibiotics * V1 Residency Crosstabulation

Count

		V1 Residency		Total
		1 Maadi	2 Shagret Mariam	
V20 Did you self-medicate with antibiotics	1 Yes	39	130	169
	2 No	263	144	407
Total		302	274	576

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	82.628[a]	1	.000		
Continuity Correction[b]	80.971	1	.000		
Likelihood Ratio	85.640	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	82.484	1	.000		
N of Valid Cases	576				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 80.39.

b. Computed only for a 2x2 table

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
V20 Did you self-medicate with antibiotics * V3 Gender	576	71.8%	226	28.2%	802	100.0%

V20 Did you self-medicate with antibiotics * V3 Gender Crosstabulation

Count

		V3 Gender		Total
		1 Male	2 Female	
V20 Did you self-medicate with antibiotics	1 Yes	55	114	169
	2 No	150	257	407
Total		205	371	576

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.968[a]	1	.325		
Continuity Correction[b]	.789	1	.374		
Likelihood Ratio	.976	1	.323		
Fisher's Exact Test				.341	.187
Linear-by-Linear Association	.966	1	.326		
N of Valid Cases	576				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 60.15.

b. Computed only for a 2x2 table

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
V20 Did you self-medicate with antibiotics * V14 Medical Insurance	576	71.8%	226	28.2%	802	100.0%

V20 Did you self-medicate with antibiotics * V14 Medical Insurance Crosstabulation

Count

		V14 Medical Insurance		Total
		1 Yes	2 No	
V20 Did you self-medicate with antibiotics	1 Yes	36	133	169
	2 No	178	229	407
Total		214	362	576

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	25.737[a]	1	.000		
Continuity Correction[b]	24.785	1	.000		
Likelihood Ratio	27.174	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	25.692	1	.000		

N of Valid Cases	576				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 62.79.

b. Computed only for a 2x2 table

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
V20 Did you self-medicate with antibiotics * V14 Medical Insurance	576	71.8%	226	28.2%	802	100.0%

V20 Did you self-medicate with antibiotics * V14 Medical Insurance Crosstabulation

Count

		V14 Medical Insurance		Total
		1 Yes	2 No	
V20 Did you self-medicate with antibiotics	1 Yes	36	133	169
	2 No	178	229	407
Total		214	362	576

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	25.737[a]	1	.000		
Continuity Correction[b]	24.785	1	.000		

Likelihood Ratio	27.174	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	25.692	1	.000		
N of Valid Cases	576				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 62.79.

b. Computed only for a 2x2 table

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
V20 Did you self-medicate with antibiotics * V8 Employment status	576	71.8%	226	28.2%	802	100.0%

V20 Did you self-medicate with antibiotics * V8 Employment status Crosstabulation

Count

		V8 Employment status			Total
		1 Working	2 Retired	3 Unemployed	
V20 Did you self-medicate with antibiotics	1 Yes	78	14	77	169
	2 No	216	45	146	407
Total		294	59	223	576

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.912[a]	2	.086
Likelihood Ratio	4.883	2	.087
Linear-by-Linear Association	3.726	1	.054
N of Valid Cases	576		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 17.31.

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
V20 Did you self-medicate with antibiotics * V4 Marital status	576	71.8%	226	28.2%	802	100.0%

V20 Did you self-medicate with antibiotics * V4 Marital status Crosstabulation

Count

		V4 Marital status				Total
		1 Single	2 Married	3 Divorced	4 Widow	
V20 Did you self-medicate with antibiotics	1 Yes	21	133	11	4	169
	2 No	45	344	4	14	407
Total		66	477	15	18	576

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.127[a]	3	.002
Likelihood Ratio	13.508	3	.004
Linear-by-Linear Association	.182	1	.670
N of Valid Cases	576		

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 4.40.

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
V20 Did you self-medicate with antibiotics * V10 Household monthly income	576	71.8%	226	28.2%	802	100.0%

V20 Did you self-medicate with antibiotics * V10 Household monthly income Crosstabulation

Count

		V10 Household monthly income		Total
		1 Less than 1500	2 1500 - 4000	
V20 Did you self-medicate with antibiotics	1 Yes	132	37	169
	2 No	155	252	407
Total		287	289	576

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	76.514[a]	1	.000		
Continuity Correction[b]	74.922	1	.000		
Likelihood Ratio	79.981	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	76.381	1	.000		
N of Valid Cases	576				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 84.21.

b. Computed only for a 2x2 table

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
V1 Residency * V7 Level of Education	802	100.0%	0	0.0%	802	100.0%
V1 Residency * V8 Employment status	802	100.0%	0	0.0%	802	100.0%
V1 Residency * V10 Household monthly income	799	99.6%	3	0.4%	802	100.0%
V1 Residency * V16 Smoking	802	100.0%	0	0.0%	802	100.0%

V1 Residency * V7 Level of Education

Crosstab

Count

		V7 Level of Education			
		1 No formal Education	2 Primary Education	3 Preparatory Education	4 High school Education
V1 Residency	1 Maadi	0	0	4	76
	2 Shagret Mariam	9	9	62	194
Total		9	9	66	270

Crosstab

Count

		V7 Level of Education		Total
		5 University Education	6 Graduate Education	
V1 Residency	1 Maadi	298	24	402
	2 Shagret Mariam	126	0	400
Total		424	24	802

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	214.310[a]	5	.000
Likelihood Ratio	244.713	5	.000
Linear-by-Linear Association	191.709	1	.000
N of Valid Cases	802		

a. 4 cells (33.3%) have expected count less than 5. The minimum expected count is 4.49.

V1 Residency * V8 Employment status

Crosstab

Count

		V8 Employment status				
		1 Working	2 Retired	3 Unemployed	4 Housewife	5 Student
V1 Residency	1 Maadi	207	17	7	136	35
	2 Shagret Mariam	183	3	40	151	23
Total		390	20	47	287	58

Crosstab

Count

		Total
V1 Residency	1 Maadi	402
	2 Shagret Mariam	400
Total		802

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	37.709[a]	4	.000
Likelihood Ratio	41.171	4	.000
Linear-by-Linear Association	1.420	1	.233
N of Valid Cases	802		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.98.

V1 Residency * V10 Household monthly income

Crosstab

Count

		V10 Household monthly income			
		1 Less than 1500	2 1500 - 4000	3 4000 - 6000	4 6000 - 8000
V1 Residency	1 Maadi	0	0	4	16
	2 Shagret Mariam	11	243	130	13
Total		11	243	134	29

Crosstab

Count

		V10 Household monthly income			Total
		5 8000 - 10000	6 10000 - 12000	7 More than 12000	
V1 Residency	1 Maadi	67	165	150	402
	2 Shagret Mariam	0	0	0	397
Total		67	165	150	799

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	754.786[a]	6	.000
Likelihood Ratio	1031.755	6	.000
Linear-by-Linear Association	686.188	1	.000
N of Valid Cases	799		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.47.

V1 Residency * V16 Smoking

Crosstab

Count

		V16 Smoking		Total
		0	1 Yes	
V1 Residency	1 Maadi	264	138	402
	2 Shagret Mariam	308	92	400
Total		572	230	802

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	12.580[a]	1	.000		
Continuity Correction[b]	12.032	1	.001		
Likelihood Ratio	12.645	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	12.564	1	.000		
N of Valid Cases	802				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 114.71.

b. Computed only for a 2x2 table

T-test of Percentage for Significant Differences

T-Test

Group Statistics

	V1 Residency	N	Mean	Std. Deviation	Std. Error Mean
V5 Children	1 Maadi	402	.82	.382	.019
	2 Shagret Mariam	400	.66	.474	.024
V11 Self-reported health	1 Maadi	402	1.12	.329	.016
	2 Shagret Mariam	400	1.08	.264	.013
V12 Chronic Illness	1 Maadi	402	.13	.341	.017
	2 Shagret Mariam	400	.08	.264	.013
V14 Medical Insurance	1 Maadi	402	.51	.500	.025
	2 Shagret Mariam	400	.13	.331	.017
V17 Antibiotics taken in last 6 month	1 Maadi	402	.24	.428	.021
	2 Shagret Mariam	400	.18	.385	.019
V18 Antibiotics taken in last 6 month (kids/family)	1 Maadi	305	.67	.470	.027
	2 Shagret Mariam	328	.62	.487	.027
V20 Did you self-medicate with antibiotics	1 Maadi	302	.13	.336	.019
	2 Shagret Mariam	274	.47	.500	.030
V24 Frequency of the dose as recommended	1 Maadi	302	1.00	.000	.000
	2 Shagret Mariam	274	.99	.120	.007
V25 Duration of antibiotics as recommended	1 Maadi	302	.99	.099	.006
	2 Shagret Mariam	274	.93	.255	.015
V26 Antibiotics treat viruses & bacteria	1 Maadi	389	.96	.193	.010
	2 Shagret Mariam	400	.84	.372	.019
V27 Going to another physician for antibiotics	1 Maadi	402	.03	.184	.009
	2 Shagret Mariam	399	.03	.157	.008
V28 Diarrheal meds in last 3 month	1 Maadi	402	.35	.478	.024
	2 Shagret Mariam	400	.21	.406	.020

V29 Constipation meds in last 3 month	1 Maadi	402	.19	.394	.020
	2 Shagret Mariam	400	.03	.171	.009
V30 History of ulcer	1 Maadi	402	.11	.319	.016
	2 Shagret Mariam	400	.07	.247	.012
V16 Smoking	1 Maadi	402	.34	.475	.024
	2 Shagret Mariam	400	.23	.421	.021
totaluse	1 Maadi	402	.7512	.43283	.02159
	2 Shagret Mariam	400	.6850	.46510	.02325

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
									Lower
V5 Children	Equal variances assumed	118.940	.000	5.375	800	.000	.163	.030	.104
	Equal variances not assumed			5.372	763.566	.000	.163	.030	.104
V11 Self-reported health	Equal variances assumed	16.166	.000	1.989	800	.047	.042	.021	.001
	Equal variances not assumed			1.990	765.014	.047	.042	.021	.001
V12 Chronic Illness	Equal variances assumed	31.337	.000	2.753	800	.006	.059	.022	.017

	Equal variances not assumed			2.755	753.710	.006	.059	.022	.017
V14 Medical Insurance	Equal variances assumed	513.139	.000	12.922	800	.000	.387	.030	.329
	Equal variances not assumed			12.935	696.062	.000	.387	.030	.329
V17 Antibiotics taken in last 6 month	Equal variances assumed	18.395	.000	2.132	800	.033	.061	.029	.005
	Equal variances not assumed			2.132	791.715	.033	.061	.029	.005
V18 Antibiotics taken in last 6 month (kids/family)	Equal variances assumed	8.636	.003	1.477	631	.140	.056	.038	-.019
	Equal variances not assumed			1.479	630.116	.140	.056	.038	-.018
V20 Did you self-medicate with antibiotics	Equal variances assumed	327.641	.000	-9.805	574	.000	-.345	.035	-.414
	Equal variances not assumed			-9.626	470.610	.000	-.345	.036	-.416
V24 Frequency of the dose as recommended	Equal variances assumed	18.375	.000	2.112	574	.035	.015	.007	.001
	Equal variances not assumed			2.011	273.000	.045	.015	.007	.000
V25 Duration of antibiotics as recommended	Equal variances assumed	61.792	.000	3.754	574	.000	.059	.016	.028
	Equal variances not assumed			3.622	347.661	.000	.059	.016	.027
V26 Antibiotics treat viruses & bacteria	Equal variances assumed	170.052	.000	5.974	787	.000	.126	.021	.085
	Equal variances not assumed			6.022	602.898	.000	.126	.021	.085
V27 Going to another physician for antibiotics	Equal variances assumed	2.631	.105	.810	799	.418	.010	.012	-.014
	Equal variances not assumed			.810	781.256	.418	.010	.012	-.014

V28 Diarrheal meds in last 3 month	Equal variances assumed	83.773	.000	4.574	800	.000	.143	.031	.082
	Equal variances not assumed			4.576	780.893	.000	.143	.031	.082
V29 Constipation meds in last 3 month	Equal variances assumed	298.620	.000	7.526	800	.000	.162	.021	.119
	Equal variances not assumed			7.539	547.156	.000	.162	.021	.119
V30 History of ulcer	Equal variances assumed	24.762	.000	2.454	800	.014	.049	.020	.010
	Equal variances not assumed			2.456	754.576	.014	.049	.020	.010
V16 Smoking	Equal variances assumed	50.719	.000	3.570	800	.000	.113	.032	.051
	Equal variances not assumed			3.572	789.536	.000	.113	.032	.051
totaluse	Equal variances assumed	17.405	.000	2.088	800	.037	.06624	.03172	.00397
	Equal variances not assumed			2.088	795.314	.037	.06624	.03173	.00396

Independent Samples Test

		t-test for Equality of Means
		95% Confidence Interval of the Difference
		Upper
V5 Children	Equal variances assumed	.223
	Equal variances not assumed	.223
V11 Self-reported health	Equal variances assumed	.083
	Equal variances not assumed	.083
V12 Chronic Illness	Equal variances assumed	.102
	Equal variances not assumed	.102

V14 Medical Insurance	Equal variances assumed	.446
	Equal variances not assumed	.446
V17 Antibiotics taken in last 6 month	Equal variances assumed	.118
	Equal variances not assumed	.118
V18 Antibiotics taken in last 6 month (kids/family)	Equal variances assumed	.131
	Equal variances not assumed	.131
V20 Did you self-medicate with antibiotics	Equal variances assumed	-.276
	Equal variances not assumed	-.275
V24 Frequency of the dose as recommended	Equal variances assumed	.028
	Equal variances not assumed	.029
V25 Duration of antibiotics as recommended	Equal variances assumed	.090
	Equal variances not assumed	.092
V26 Antibiotics treat viruses & bacteria	Equal variances assumed	.168
	Equal variances not assumed	.168
V27 Going to another physician for antibiotics	Equal variances assumed	.033
	Equal variances not assumed	.033
V28 Diarrheal meds in last 3 month	Equal variances assumed	.205
	Equal variances not assumed	.205
V29 Constipation meds in last 3 month	Equal variances assumed	.204
	Equal variances not assumed	.204
V30 History of ulcer	Equal variances assumed	.089
	Equal variances not assumed	.089
V16 Smoking	Equal variances assumed	.176
	Equal variances not assumed	.176
totaluse	Equal variances assumed	.12852
	Equal variances not assumed	.12853

APPENDIX G

Mann-Whitney U Test

1) Mann-Whitney Test

Residency and Household income = significant difference

Ranks

	V1 Residency	N	Mean Rank	Sum of Ranks
V10 Household monthly income	1 Maadi	402	588.62	236627.00
	2 Shagret Mariam	397	209.00	82973.00
	Total	799		

Test Statistics[a]

	V10 Household monthly income
Mann-Whitney U	3970.000
Wilcoxon W	82973.000
Z	-26.869
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: V1 Residency

2) Mann-Whitney Test

Residency and self-reported health = significant difference

Ranks

	V1 Residency	N	Mean Rank	Sum of Ranks
V11 Self-reported health	1 Maadi	402	409.42	164588.00
	2 Shagret Mariam	400	393.54	157415.00
	Total	802		

Test Statistics[a]

	V11 Self-reported health
Mann-Whitney U	77215.000
Wilcoxon W	157415.000
Z	-1.914
Asymp. Sig. (2-tailed)	.056

a. Grouping Variable: V1 Residency

3) Mann-Whitney Test

Residency and having chronic disease = significant difference

Ranks

	V1 Residency	N	Mean Rank	Sum of Ranks
V12 Chronic Illness	1 Maadi	402	389.63	156633.00
	2 Shagret Mariam	400	413.43	165370.00
	Total	802		

Test Statistics[a]

	V12 Chronic Illness
Mann-Whitney U	75630.000
Wilcoxon W	156633.000
Z	-2.742
Asymp. Sig. (2-tailed)	.006

a. Grouping Variable: V1 Residency

4) Mann-Whitney Test

Residency and having health insurance = significant difference

Ranks

	V1 Residency	N	Mean Rank	Sum of Ranks
V14 Medical Insurance	1 Maadi	402	324.01	130253.00
	2 Shagret Mariam	400	479.38	191750.00
	Total	802		

Test Statistics[a]

	V14 Medical Insurance
Mann-Whitney U	49250.000
Wilcoxon W	130253.000
Z	-11.761
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: V1 Residency

5) Mann-Whitney Test

Residency and smoking = significant difference

Ranks

	V1 Residency	N	Mean Rank	Sum of Ranks
V16 Smoking	1 Maadi	402	380.92	153131.00
	2 Shagret Mariam	400	422.18	168872.00
	Total	802		

Test Statistics[a]

	V16 Smoking
Mann-Whitney U	72128.000
Wilcoxon W	153131.000
Z	-3.167
Asymp. Sig. (2-tailed)	.002

a. Grouping Variable: V1 Residency

6) Mann-Whitney Test

Residency and Antibiotics Consumption in Adults

Ranks

	V1 Residency	N	Mean Rank	Sum of Ranks
V17 Antibiotics taken in last 6 month	1 Maadi	402	389.24	156475.00
	2 Shagret Mariam	400	413.82	165528.00
	Total	802		

Test Statistics[a]

	V17 Antibiotics taken in last 6 month
Mann-Whitney U	75472.000
Wilcoxon W	156475.000
Z	-2.127
Asymp. Sig. (2-tailed)	.033

a. Grouping Variable: V1 Residency

7) Mann-Whitney Test

Residency and Antibiotics Consumption for children/care givers

Ranks

	V1 Residency	N	Mean Rank	Sum of Ranks
V18 Antibiotics taken in last 6 month (kids/family)	1 Maadi	305	307.77	93870.00
	2 Shagret Mariam	328	325.58	106791.00
	Total	633		

Test Statistics[a]

	V18 Antibiotics taken in last 6 month (kids/family)
Mann-Whitney U	47205.000
Wilcoxon W	93870.000
Z	-1.475
Asymp. Sig. (2-tailed)	.140

a. Grouping Variable: V1 Residency

8) Mann-Whitney Test

Residency and total use of antibiotics

Ranks

	V1 Residency	N	Mean Rank	Sum of Ranks
totaluse	1 Maadi	402	414.75	166729.00
	2 Shagret Mariam	400	388.19	155274.00

	Total	802		

Test Statistics[a]

	totaluse
Mann-Whitney U	75074.000
Wilcoxon W	155274.000
Z	-2.084
Asymp. Sig. (2-tailed)	.037

a. Grouping Variable: V1 Residency

9) Mann-Whitney Test

Residency and SMA

Ranks

	V1 Residency	N	Mean Rank	Sum of Ranks
V20 Did you self-medicate with antibiotics	1 Maadi	302	335.81	101414.00
	2 Shagret Mariam	274	236.36	64762.00
	Total	576		

Test Statistics[a]

	V20 Did you self-medicate with antibiotics
Mann-Whitney U	27087.000
Wilcoxon W	64762.000
Z	-9.082
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: V1 Residency

10) Mann-Whitney Test

Residency and Antibiotics treating viruses and bacteria

Ranks

	V1 Residency	N	Mean Rank	Sum of Ranks
V26 Antibiotics treat viruses & bacteria	1 Maadi	389	369.28	143650.00
	2 Shagret Mariam	400	420.01	168005.00
	Total	789		

Test Statistics[a]

	V26 Antibiotics treat viruses & bacteria
Mann-Whitney U	67795.000
Wilcoxon W	143650.000
Z	-5.943
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: V1 Residency

Table 7 showing the p values of Mann-Whitney U test on different variables.

Mann-Whitney Test for Significance		
Variables	**p Value**	**z score**
Residency and Income	0.000	-26.869
Residency and Self-reported health	0.056	-1.914
Residency and Having a Chronic Illness	0.006	-2.742
Residency and Having Health Insurance	0.000	-11.761
Residency and Smoking	0.002	-3.167
Residency and Antibiotics Consumption in Adults	0.033	-2.127
Residency and Antibiotics Consumption for children/care givers	.140	-1.475
Residency and Total Consumption of Antibiotics per Family	0.037	-2.084
Residency and SMA	0.000	-9.082
Residency and Antibiotics treats viruses and bacteria	0.000	-5.943

3.9 Significance of Differences between the Two Areas

3.9.1 Residency and Income

A Mann-Whitney Test was done to assess if the difference between the levels of income and the residency is significant or not. The test showed a significant difference in levels of income between Maadi (n = 402) and Shagret Mariam (n = 400) with p value = 0.00. Income was significantly higher in high-income areas compared to low-income areas.

3.9.2 Residency and Self-reported health

Another Mann-Whitney Test was done to assess the status of self-reported health and residency and it showed a significant difference in the self-report health in the two areas; Maadi and Shagret Mariam with p value = 0.05. In lower-income areas, “good” self-reported health status was reported more than in the high-income area.

3.9.3 Residency and Having a Chronic Illness

Identifying if there is a significant relationship between residents of Maadi and Shagret Mariam in terms of having a chronic illness was illustrated by Mann-Whitney test. Test results showed significant difference between the two areas in terms of having chronic disease p value = 0.006. In the high-income area, double the number of participants had chronic diseases compared to the low-income areas indicating that with higher socioeconomic levels, people would report having chronic diseases

3.9.4 Residency and Having Health Insurance

A significant difference was indicated when running a Mann-Whitney Test between the residency (area) and having a health insurance with a p value = 0.00. In the high-income area, participants who had health insurance coverage was four times more than in the low-income area.

3.9.5 Residency and Smoking

Significant difference between smokers in Shagret Mariam and Maadi examined using Mann-Whitney test which showed that higher number of smokers where found more in the high-income area than in the lower p value = 0.002.

3.9.6 Residency and Antibiotics Consumption in Adults/ Study Participants

Mann-Whitney test showed a significant difference in the consumption of antibiotics by adults between Maadi and Shagret Mariam with a p value = 0.033. Maadi residents (high-income area) consumed more antibiotics than in the lower-income area.

3.9.7 Residency and Antibiotics Consumption for children/care givers

hen testing antibiotic consumption but for children and care receivers, there was no significant difference between the levels of consumption in Maadi and in Shagret Mariam with a p value = 0.140. In both the high and low-income areas, consumption of antibiotics by care receivers was not significantly different.

3.9.8 Residency and Total Consumption of Antibiotics per Family

Mann-Whitney test was conducted to assess the prevalence of antibiotic consumption (total/per family) and the area of residency (socioeconomic level). A significant relationship was observed with p value = 0.037. Higher rates of total antibiotics consumptions were found in the high-income area compared to the low-income area.

3.9.10 Residency and SMA

Mann Whitney test between SMA and residency (socioeconomic level represented in the area) revealed a significant difference between Maadi and Shagret Mariam and prevalence of SMA with p value = 0.000. Prevalence of SMA was found to be significantly higher in low-income areas more than in high-income areas.

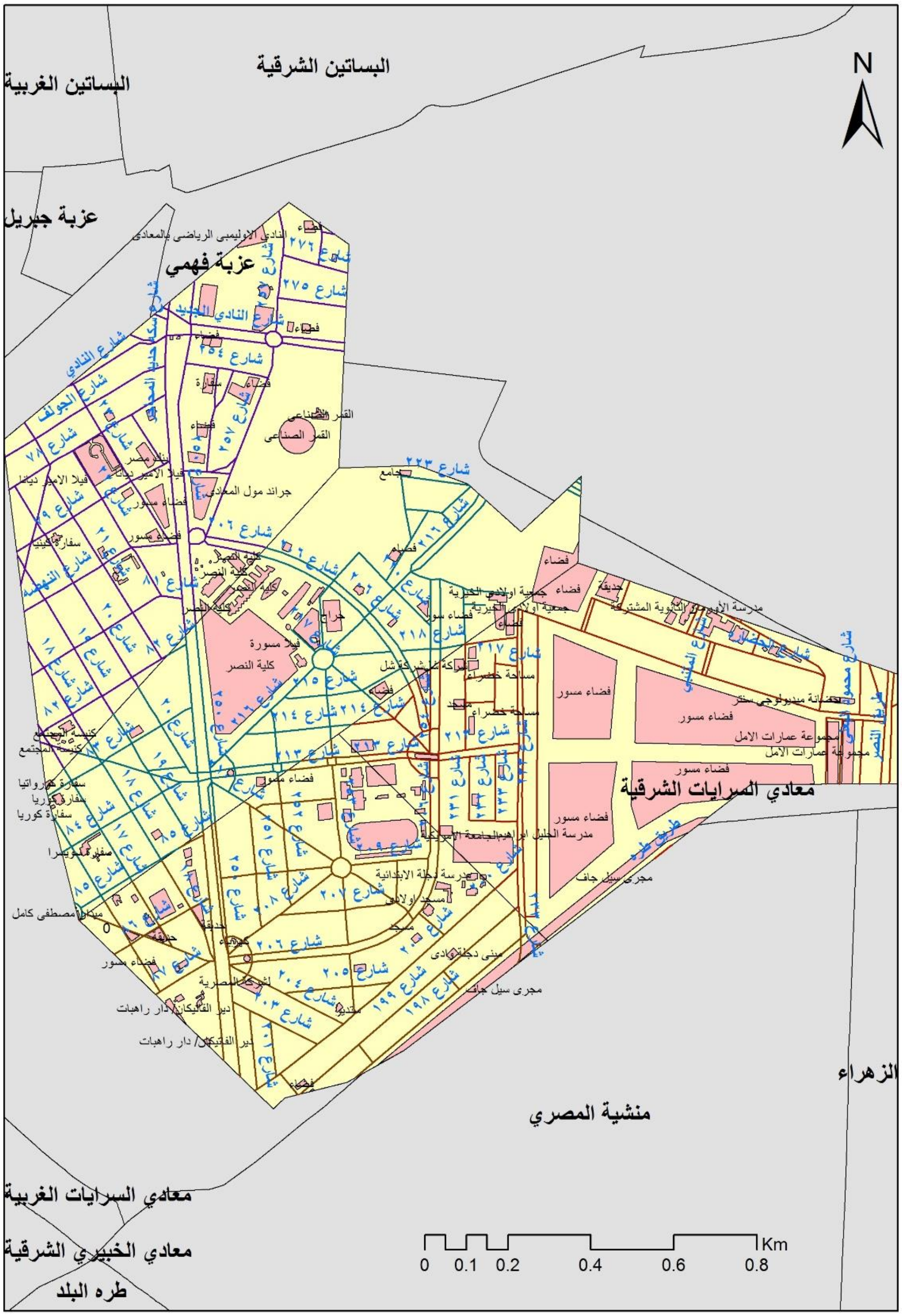
3.9.11 Residency and Antibiotics treats viruses and bacteria

Knowledge on antibiotics' effectiveness in treating bacterial and viral infection was assessed if significantly different in the two areas. Results showed a significant relationship with p value = 0.000.

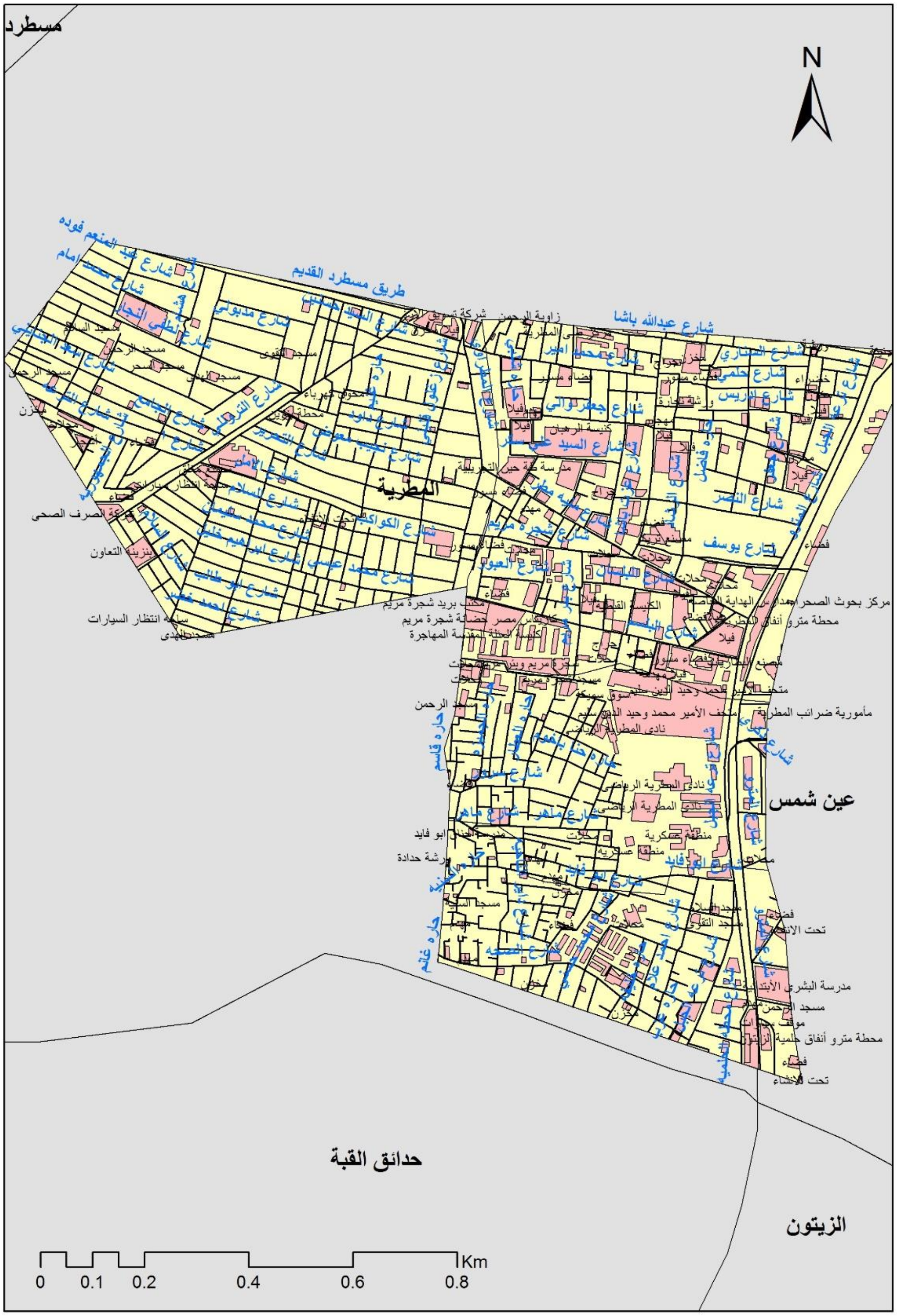
APPENDIX H

Maps of Maadi and Shagret Mariams

معادى السرايات الشرقية



شجرة مريم، المطرية البحرية، المطرية القبلية ، والمطرية الغربية١



Appendix I

Approval of IRB

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Shaymaa Hassan** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 06/13/2017.

Certification Number: 2414425.

Appendix J

APDI index for Area Selection

Habitat International 34 (2010) 264–272

Contents lists available at ScienceDirect

Habitat International

journal homepage: www.elsevier.com/locate/habitatint

Using GIS in constructing area-based physical deprivation index in Cairo Governorate, Egypt

Zeinab Khadr [a,b,*], Mohamed Nour el Dein [a,c], Ramadan Hamed [a,b]

[a] Social Research Center, American University in Cairo, AUC Avenue, P.O. Box 74, New Cairo 11835, Egypt
[b] Department of Statistics, Cairo University, Cairo-Giza, Egypt
[c] Department of information systems, Cairo University, Cairo-Giza, Egypt

Keywords:
Cairo
Informal settelment
Slums
GIS

A B S T R A C T

A worldwide consensus on poverty has acknowledged slums and the living conditions of slum dwellers as a major challenge faced by humanity. Formulation of appropriate policies and intervention programs to improve the living conditions and secure the well being of slum dwellers requires a strong knowledge base that clearly defines, identifies, and signifies the main points of commonalities and diversities among these slum areas which are commonly unavailable in many cities in developing countries. The current research provides an overview of slum challenge in Cairo governorate, Egypt. It further develops a physical deprivation index that allows the ranking of small geographic areas accordingly to their levels of physical deprivation. Using four of the basic GIS layers for the governorate of Cairo and the principle component analysis, an index of physical deprivation for these small areas "*mantiqas*" is constructed. The proposed index is a composite index of four main dimensions characterizing physical attributes, sources of pollutions, available services and security of each mantiqa. Validation tests of the index revealed the ability of the proposed index to capture slums identified by the current governmental official list of slums in addition to other areas that were as equally deprived but not included in the official list of slums.

Introduction

A worldwide consensus on poverty has acknowledged slums and the living conditions of slum dwellers as a major challenge faced by humanity. UN Habitat (2003) estimated that more than one billion people are currently living in slums. Only 6% of those slum dwellers reside in developed countries with a growth rate estimated at over 0.5% over the ten years (1990–2001). In contrast, 94% of the slum dwellers live in developing countries with a growth rate of 2.4% per year over the same period (UN Habitat, 2006). This rate means that in less than 30 years, the slum population in developing countries will be double in size.

Fuelled by rapid population growth and continuing influx of rural migration, many cities in the developing countries are faced with expanding numbers of slums and squatter settlements. Such settlements contribute substantially to exacerbating the problems of urban congestion and sprawl in these cities, and outstripping their capacity to provide adequate basic services for their population.

Recently, various series of global commitments have placed issues of slum dwellers' living conditions higher on the policy agendas of international agencies and national governments. The culmination of these commitments was the eleventh target of the United Nations Millennium Development under Goal 7 aimed at "Achieving significant improvement in the lives of at least 100 million slum dwellers by 2020."

At the national level, many countries have shown a commitment to addressing the slum challenge through adopting a wide spectrum of policy approaches that range from negligence, eviction, and resettlement to slum upgrading and self-help projects (UN Habitat, 2003). Only countries that adopted a holistic approach in dealing with the slum challenge were able to control the growth of urban slums (UN Habitat, 2003). Most of these successful experiences launched policies and projects that combine large-scale slum upgrading, tenure regularization programs and development of low-cost housing options.

Nevertheless, the formulation of appropriate policies and intervention programs requires a strong knowledge base that clearly defines, identifies, and signifies the main points of commonalities and diversities among these slum areas which are commonly unavailable in many cities in developing countries. The current research attempts to fill this gap by developing a measure of area-based physical deprivation for small geographic areas within urban settings.

* Corresponding author. Social Research Center, American University in Cairo, AUC Avenue, P.O. Box 74, New Cairo 11835, Egypt. Tel.: +202 2797 6967; fax: +202 2795 7298.
E-mail address: zeinabk@aucegypt.edu (Z. Khadr).

0197-3975/$ – see front matter © 2009 Elsevier Ltd. All rights reserved.
doi:10.1016/j.habitatint.2009.11.001

The current research is part of a larger project on urban inequity in the Cairo Governorate. Commissioned by the UN Habitat, the "Urban Inequity" study's main objectives were to investigate differentials among the living conditions in various neighborhoods in the governorate of Cairo and their impact on family and individual welfare; with particular emphasis on slums and informal settlement dwellers. In fielding this study, the research team, aiming to have a representative sample from the various neighborhoods of the Cairo governorate, was confronted with a heated debate on the definitions of slums. This debate contributed to the inability to provide a complete listing of Cairo neighborhoods ranked by their level of physical deprivation. The current research addresses this limitation and develops a measure that enables various stakeholders, including policy makers and researchers, to rank small geographic areas accordingly to their levels of physical deprivation. This proposed measure draws upon the available information in basic GIS layers. It produces a gradient of physical deprivation for small geographic areas which in turn provides policy makers and program officers with a tool that enables them to focus on the most deprived small areas for upgrading efforts and interventions.

The Cairo governorate: the study site

The Cairo governorate or the city of Cairo is the main sector in the built-up conurbation of the greater Cairo Metropolitan area. Except for a few scattered towns, the other two sectors of the Greater Cairo Metropolitan are located in the urbanized section of two adjacent governorates; namely Giza lying on the west bank of the Nile and Qualubya in the north of the Cairo governorate. Geographically, the Cairo governorate extends over the east bank of the Nile from Shubra in the north and Heliopolis and Nasr City in the northeast to Helwan in the south (Fahmi & Sutton, 2008). Administratively, Cairo is divided into 292 *shiakhas*. The *shiakha* is the minimum administrative unit for which the Central Agency for Public Mobilization and Statistics (CAPMAS) publishes census and other data. These *shiakha* vary in size ranging from 0.02 km^2 (Safi el Dein) to 19.765 km^2 (El Mokatom). Each of these *shiakha* has a separate administration through which they are managed under the authority of the governor.

Demographically, and according to the 2006 census, Cairo governorate houses 7.79 million of the 18.29 million population of Greater Cairo (CAPMAS, 2008a). Its rapid growth has evolved in three stages since World War II, between 1947 and 2006. During the first stage (1947–1966), the city's population grew two fold from 2.09 million to more than 4.22 million as a result of high rates of rural to urban migration during this period. Through 1970s to 1990s, natural growth was the main dynamic underlying city growth and an average growth rate of 1.6% per year. Over the last decade (1996–2006) the population growth slowed and growth rate reached 1.4% per year (CAPMAS, 2008a, 2008b).

The challenge of slums in Cairo[1]

Similar to the experience of many developing countries, Egypt is plagued by the challenge of slums and informal settlements. It is often cited as exemplifying slum infested cities in developing countries (Harris & Wahba, 2002). However, Cairo slums and informal settlements also exhibit some distinctive characteristics that can only be understood by exploring the main factors that led to their existence and sustainability over more than six decades. In reality, there is no official documentation on the history of slums and informal settlements in Cairo. Nevertheless, many studies have tied their emergence and progressive growth to the failure of state housing policies, laws, and delivery systems in Egypt (El Araby, 2003; Fahmi & Sutton, 2008; Harris & Wahba, 2002) combined with State indifference and inaction in sanctioning their growth (Dorman, 2007).

According to these studies, the emergence and growth of the slums and informal settlements evolved gradually over the last six decades. The beginning occurred during the period of 1950s through 1960s with a series of deliberate governmental policy choices in the housing industry and urban land use that tightened the housing market for the middle and low-income populations (El Batran & Arandel, 1998; Harris & Wahba, 2002; Shora Council, 2009; Sims, 2003). These include heavy governmental involvement in the public housing projects during the early 1960s, followed by significant withdrawal during the late 1960s. In response to the massive rural migration influx to the city that was attracted by the high concentration of public-sector industries in the city, public housing and civil servant housing projects were launched by the socialist government to meet the resultant excess demand for housing. These projects were constructed around newly established industrial centers and on the outskirts and cleared "slum" areas of the city (Fahmi & Sutton, 2008). The target in the Five Year-Plan 1960–1965 was to fund building 14,500 units through the nationalized policy (El Araby, 2003). However, the government was only able to finance and construct 5000 units in 1950s and early 1960s (Harris & Wahba, 2002; Soliman, 1995). The harshest blow to the governmental contribution to these projects came during the period between 1965 and 1975 when high priority was accorded to the military expenses as a result of a quasi-permanent state of war in Egypt and the rise in the construction costs (El Araby, 2003; Harris & Wahba, 2002).

Rent control laws were another factor that played a significant role in the emergence of slums and informal settlements (El Araby, 2003). These laws were first inaugurated in 1947 with the objective of protecting low-income households from the high cost of housing. Starting 1952, this law has been successively amended with changes that have critically jeopardized the rental housing market. These changes encompassed a major reduction in the previously fixed rents, giving tenants more rights over their rented units and restraining the power of the landlords in dealing with their properties (El Araby, 2003). These laws resulted in diverting the housing market away from rental housing to owner-occupied housing (El Araby, 2003; Harris & Wahba, 2002).

The minority who maintained their contribution to the rental housing market resorted to the illegal practice of "key money" in order to evade rigidly under-priced rents and secure a return on rental units. This "key money" was an informal lump sum of money that is paid outside the contract payment (El Araby, 1994, 2003). It was supposedly equivalent to the difference between regulated rent and the actual cost. The "key money" was usually beyond the means of most middle and low-income populations. Moreover, due to its illegal nature, many landlords were forced to sell their units rather than rent them. This practice led to a peculiar phenomenon in the housing market of Cairo in which rising demand for affordable housing units co-existed with hundreds of thousands vacant housing units held off the housing market (Fahmi & Sutton, 2008).

In addition to tightening the rent market for middle and low class, rent control laws contributed to the deterioration of the available rental housing stock (Fahmi & Sutton, 2008). Many landlords displaced responsibility for building maintenance onto their tenants as maintenance costs exceeded the collected rents from these buildings (Mayo, 1982) which eventually led to reducing investment in the old properties and their deterioration over time.

During this period, confronted with their inability to afford newly built housing or to secure the required "key money" for rental housings, many middle and low-income families were pushed to

[1] This section relies heavily on three main research papers, namely El Araby, 2003; Fahmi & Sutton, 2008; and Harris & Wahba, 2002.

adopt various coping mechanisms. Filtering down of existing housing stock and sharing accommodation became the norm during this period (Fahmi & Sutton, 2008). Anthropological studies in the1970s reported that in these inner city neighborhoods, sharing accommodations was a common practice and many families lived in single rooms and shared other housing utilities, including kitchen and bathrooms (Rugh, 1979; Singerman, 1995). This situation led to increased crowdedness and accelerated housing unit deterioration.

Extensions to existing buildings in established neighborhoods were another coping mechanism implemented by middle and low-income families (Harris & Wahba, 2002). These extensions took the form of vertical extensions or multistory building side extensions. In the case of vertical extension, the roofs of buildings offered convenient and cheap space for new construction. It is worth noting that these extensions were not limited to low-income areas of the city. They were carried out in the more affluent districts and involved the building of quite expensive units (Harris & Wahba, 2002).

The majority of these extensions was carried out informally and without proper permits and in most cases endangered the original building structures by placing extra strain on them. In 1970s, some researchers estimated that this type of informal extension accounted for more than half of all the net addition to Cairo housing stock (Mayo, 1982).

Other forms of extension were adopted by middle and low-income families in Cairo. These extensions took the form of informal addition of rooms or balconies, or extra space within buildings (Harris & Wahba, 2002). Some went as far as adding multistory side extensions. These additions were most prevalent in the formal public housing where tenants would illegally redesign and rearrange their space to suit their needs by erecting partitions and adding and inventing new space (Harris & Wahba, 2002).

Another unusual coping mechanism adopted by low class families was the conversion of cemeteries into residential areas. Abu-Lughod (1981) showed that cemeteries have for long housed small numbers of families. In 1937, 10,000 people were living in cemeteries. By 1967, this number increased to reach 100,000 persons. By 1997, it is estimated that more than a million persons were residing in the cemeteries in Cairo (Nedoroscik, 1997).

During this period, informal settlements started to emerge on small scale through individual initiatives with the aim to secure accommodation mainly on agricultural land surrounding the city. In the meanwhile, the combination of the process of filtering down in old neighborhoods, the absence of maintenance and investments in old properties, low governmental investments in infrastructure and neglect led to the existence of inner city slums during this period (Fahmi & Sutton, 2008).

By 1975 and in response to the escalating housing crisis, the Egyptian government announced its willingness to shoulder the responsibility for tackling the housing crisis for the low-income families and requested private sector to help in bearing the responsibility for provision of housing units for the middle and high-income families (El Araby, 2003). This period also witnessed some changes in the housing laws that allowed tax exemption for private investors in the construction market (Fahmi & Sutton, 2008).

These two policies, supported by the influx of Arab and foreign investments in Egypt as a result of the open door policy during this period, contributed to the active engagement of the formal private investors in the construction of upper and middle-income housing within the city limits and in new cities at the city fringes (Fahmi & Sutton, 2008). The wide range of construction activities within the private sector resulted in substantial increases in the prices of land within and around the city.

To avoid the rising land prices in the inner city, the government fulfilled its commitment to constructing low-income housing units in new towns in the desert, such as New Bader town and 10th of Ramadan (Fahmi & Sutton, 2008). However, many of these newly developed public housing units were left unoccupied due to their elevated prices, the remoteness of these cities and their poor basic and social services. Many middle and low-income families preferred to remain in their familiar yet overly crowded residences within the city limits rather than relocate to these new towns (Denis, 1997).

Inflow of remittance from Egyptians working in oil-producing countries in the region encouraged many small investors to become involved in the construction activities in the city (El Batran & Arandel, 1998; Fahmi & Sutton, 2008). Nevertheless, soaring prices of land within the city and the complicated and long-term process required to obtain legal construction documents drove many small investors to engage in illegal construction on the city fringe (El Batran & Arandel, 1998). The illegal nature of these buildings emerged from either subdividing privately-owned agricultural lands without formal and proper subdivision documents or encroachment on state-owned land that did not have an explicit public owner. The 1970s and early 1980s witnessed the burgeoning of informal settlements as they accounted for more than 75% of all new housing during this period (Mayo, 1982).

Unable to afford the high prices of newly built formal housing in the city or in the new settlements and towns, many of newly formed households had no affordable alternative but to enter the informal housing market (Bayat & Denis, 2000) which contributed to the flourishing of the informal housing market and the progressive growth of the informal settlements during this period. This trend was furthermore aggravated by the more recent amendments to rent law in 1996, which aimed to increase the availability of rental housing units stock (El Araby, 2003). Unfortunately, the application of this law contributed to increase the rental values substantially, intensify the exclusion of middle and low-income families from the rental housing market and pushing them towards the more affordable housing stock in the informal settlements on the fringes of the city (El Araby, 2003; Fahmi & Sutton, 2008).

The current official situation of slums and informal settlements in Greater Cairo and the governorate of Cairo were presented in a report to the Shora Council (2009). It estimated that 30% of Egypt's urban population (12.2 million) lives in 1221 slums or informal settlements. Major cities (Cairo and Alexandria) are the most afflicted cities in Egypt with the challenge of slums. CAPMAS estimates that more than 3.1 million residents in the city of Cairo live in 81 slum area or informal settlements occupying 39 km^2 in 31 *shiakhas* of the 292 *shiakhas* of Cairo (Shoura Council, 2009). These areas are characterized by high population density mounting to almost double the average for the whole city (79,000/inhabited km^2 in slums compared to 41,000/inhabited km^2 for whole city) (CAPMAS, 2008b). However, these figures should be considered with caution as they are based on the official definition of slums in Egypt, which reads as follows: "Slums are neighborhoods that have been constructed in absence of planning and beyond the supervision of formal governmental administrative and planning bodies. They are in violation of building and urban planning codes and represent an intrusion on agriculture land and/or state property. In most cases, they are deprived from the minimum standards of services and infrastructure" (Shoura Council, 2009). With its focus on the legal status of the buildings and their adherence to the building codes and regulations, this definition fails to recognize some of non visible inner city slums. Recent study, using satellite images for Greater Cairo, confirmed this underestimation (Ibrahim, 2009). In this study, using data from remote sensing and satellite maps, Ibrahim (2009) attempted to estimate the location and size of slum areas in Greater Cairo. The criteria he used to designate an area as slum included: (1) seeing an informal pattern when studying the satellite images; (2) deterioration of the roads, communication networks and insufficient internal accessibility; (3) limited space and open areas; and (4) lack of basic services. The study estimated that the total slum area in Greater Cairo amounts to 133 km^2, an estimate that far exceeded the official estimate of 119 km^2. Verification of the area identified as slums was carried out through field visits. The same methodology was applied to the Giza segment of Greater Cairo with the involvement and training of the local administration as to the application of this methodology. The official report of the area of slums in Giza was 56 km^2. Early application of the methodology showed that the total slum area in Giza was estimated to cover 62.3 km^2. Local administration, equipped with training on the methodology, was able to map a total area of 73.3 km^2 with precise boarders for each slum area. The official underestimation of the total slum and informal settlement clearly and significantly affects the allocation of upgrading efforts of these areas. It also points to a misuse of resources as some large informal settlements on the city fringes have received substantial upgrading efforts and regularization, while other unidentified inner city slums were left out to deteriorate.

Geographic information system and area-based physical deprivation index (APDI)

The lack of a common definition that clearly defines, identifies and signifies the main points of commonality and diversity among slum areas coupled with rapid dynamic growth of slums and informal settlements, are commonly recognized as the main obstacle in monitoring the growth of these areas as well as planning and fielding upgrading efforts. By 2002 UN Habitat, in response to the paucity of information on slums, devised a group of 5 indicators to locate slum areas based on their dwellers' access to basic needs. These indicators allow the classification of the smallest enumeration area within the city into either slum or non slum area-based on concentration of housing units that suffer from lack of water, lack of to sanitation, overcrowding, tenure and nondurable structures. In 2008, UN Habitat and World Bank organized a peer review to assess the UN Habitat approach to monitoring Target 11 in MDGs, in particular a scientific evaluation of the definition of a slum. One of their main recommendations was the need to incorporate spatial contiguousness into the measurement of slums through the use of high resolution remote sensing and GIS (UN Habitat, 2008). In assessing the feasibility of remote sensing in detecting slums, Turkstra (2008) argued that the 5 criteria identified by UN Habitat are difficult to detect using remote sensing images. Remote sensing images can only detect informality, high density, irregular morphology and spatial clustering which can be used to identify visible slums. He further argued that non visible slums exemplified by planned but deteriorating inner cities might be hard to detect using remote sensing images.

The current study expands the use of remote sensing in the identification of slum areas through quantifying and summarizing the criteria used in the remote sensing (informality, high density, irregular morphology and spatial clustering) and other important landmarks and land use criteria in an index that reflects the physical deprivation of a geographical zone.

Data for area-based physical deprivation index (APDI)

Data for the construction of the Area-based Physical Deprivation Index (APDI) are based on GIS maps for the Cairo governorate. The application of GIS in Egypt can be traced to the late 1980s. At this time, CAPMAS, recognizing the potentials of GIS, initiated a geographical system that combined remote sensing maps developed by the Egyptian Surveying Authority with the information on various landmarks from the latest housing census. The system is updated with each new housing censes. For the periods between censuses, updates to the system are carried out by licensed private GIS companies under the auspice and approval of CAPMAS.

The maps used in the current study are the December 2005 version of GIS maps for the Cairo governorate. Two groups of maps/layers are used in this analysis. The first group is usually referred to as "Linear Objects" maps that include two layers: (1) the administrative layer that shows the administrative boundaries of each *shiakha* in Cairo and (2) the roads and irrigation systems layer that shows the network of streets, roads and irrigation systems. The second group is usually referred to as the "Surface Objects" layers and includes (1) residential buildings layer that shows the area and positions of the main residential building within the administrative boundaries for each *shiakha* and (2) landmark layer that shows the area and positions of the main landmarks within the administrative boundaries for each *shiakha*.

Building the database for the index

Subdivision of large Shiakha

Since the primary focus of constructing the current index was to produce a gradient for small geographic areas (referred to as "Mantiqas") within Cairo governorate, an area size of 0.5 km^2 was arbitrary selected on the assumption that it represents a reasonable size for containing both residential building and social services within its boundaries. As the main objective of the original study was to investigate the impact of living conditions in urban neighborhoods and the well-beings of their residents, the analysis was limited to the geographical units that encompass residential building or housing facilities. Two exceptions to this restriction were the two cemetery shiakhas, namely "El Emameen" and "El Basateen". Although these two shiakhas encompass no residential areas, they are the clearest example of encroaching on cemeteries and their transformation into residential units (or what is titled in the literature as the "city of the dead,") and therefore, 50% of their cemetery area was assigned to residential buildings.

Out of the 292 *shiakhas* of the Cairo governorate, five *shiakhas* were excluded from the subdivision process since they had no

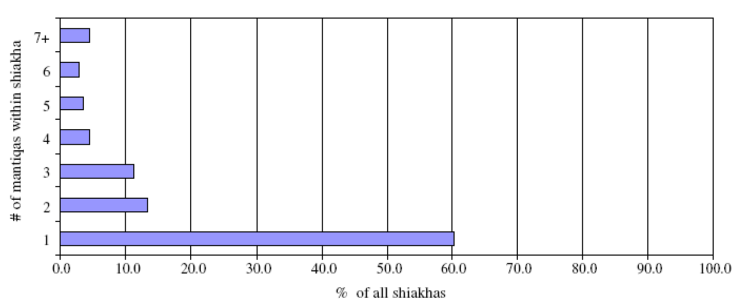


Fig. 1. Distribution of the Governorate of Cairo's Shiakhas by the number of subdivisions into mantiqas.

Table 1
Distribution of the 668 Cairo governorate *mantiqas* by their area size.

Area of the *mantiqa*	No. of *mantiqas*	Distribution (%)
0.02–0.1	55	8.7
0.1–0.2	82	12.9
0.2–0.3	69	10.9
0.3–0.4	84	13.2
0.4–0.5	81	12.8
0.5–0.6	100	15.8
0.6–0.7	157	24.8
0.7–0.8	29	4.6
0.8+	5	0.8
Total	634	100
Average size (Std)	0.424 (0.221)	

residential buildings. As some areas were less than 0.5 km^2, only 114 underwent this geographical subdivision process, and 173 *shiakhas* (60% of all *shiakhas*) were not subdivided. The subdivision process was carried out within the boundaries of the *shiakha* in order to facilitate communicating the study results to local administrative bodies for each *shiakha*. The process started from the northeast towards the southwest of each *shiakha* with some flexibility to accommodate the shape of the *shiakha*. Instead of cutting across some of the main landmarks of the mantiqa, the boundaries were aligned with the intersections of main streets encircling the predetermined size. Based on this process, the 287 *shiakhas* of Cairo were subdivided into 663 *mantiqas*.

The subdivision process resulted in excluding 29 *mantiqas* as they were found to encompass no residential buildings or housing facilities. The final number of *mantiqas* was 634 with an average size of 0.424 km^2 and with a standard deviation of 0.221 km^2.

The number of *mantiqas* within each *shiakha* varied by the *shiakha's* size. Fig. 1 shows that 24.4% of all *shiakhas* were divided into two to three *mantiqas* while 15.3% were subdivided into four or more *mantiqas*. The largest number of *mantiqas* was found in El Mokatum *shiakha* which was subdivided into 26 *mantiqas* followed by Berket el Nasr *shiakha* which was subdivided into 17 *mantiqas* (Table 1).

Geographical database for Mantiqas

Information available from the four GIS maps was structured in a form appropriate for the construction of the APDI. Originally, data in these maps were expressed in terms of geographical areas, e.g. the residential building map shows the area containing residential building, while the landmarks map shows the area containing landmarks such as the area of schools, factories…etc. within the specified geographical area. Tests were carried out to determine the most appropriate forms for different items to be included in the construction of the index, in particular whether to use areas or counts. Repeated trials revealed that the most appropriate way to handle the data was to distinguish between two types of measures; namely, area measures and count measures. The area measure was expressed in terms of a proportion between the area of a specified item or landmark to a total area. This type of measure was used for items in which this proportion would capture an important dimension in the identification of slums including areas with residential building, agricultural land, and empty space. The count measures were used to capture the variations among the various mantiqas by the presence of different landmarks including hospitals, factories, and workshop. Based on these specifications, a complete database was constructed for all mantiqas in the Cairo governorate.

Methodology: construction of the index

Construction of the APDI implemented the principle component factor analysis which allows for the identification of the weights for various items included in the proposed index. Technically, the first

Table 2
Factor score and summary statistics for the items included in the area-based physical deprivation.

Items	Factor loading	Mean	Std. dev.	Min	Max	Factor loading / Std. dev.
Physical characteristic of area						
% residential building of total inhabited	0.143	27.884	19.146	0.024	85.778	0.007
% of street area of total area	−0.257	12.457	5.454	0.278	38.764	−0.047
Dominant type of roads narrow	0.209	0.492	0.500	0	1	0.418
% of garden of total area	−0.036	1.423	3.667	0	40.947	−0.010
% of agricultural area of total area	0.053	1.937	7.512	0	73.150	0.007
% of space area of total area	0.048	2.972	6.348	0	54.962	0.008
Presence of cemetery area	0.030	0.135	0.342	0	1	0.088
No. of agricultural canal	0.067	0.143	0.438	0	3	0.153
Sources of pollutions						
No. of factories	0.084	1.178	3.387	0	35	0.025
No. of workshops	0.138	0.683	1.409	0	10	0.098
No of storages	0.141	1.125	1.800	0	14	0.078
Services in the area						
No. of governmental offices	−0.054	1.914	2.473	0	23	−0.022
No. of banks	−0.035	0.189	1.261	0	24	−0.028
No. of hotels and motels	−0.134	0.172	0.850	0	16	−0.158
No. of academic institutes	−0.074	0.266	0.687	0	5	−0.108
No. of hospitals	−0.038	0.651	1.060	0	9	−0.036
No. of bakeries	0.110	0.391	0.708	0	5	0.155
No. of entertainment sites (cinemas, theaters)	−0.079	0.424	1.359	0	16	−0.058
No. of social and sport clubs	−0.066	0.578	1.006	0	7	−0.066
Presences of security						
No. of embassies	−0.058	0.187	1.338	0	20	−0.043
No. of military sites	−0.051	0.660	1.136	0	7	−0.045
Physical deprivation index		0.000	0.892	−3.338	2.2822	

Table 3
Summary measures of the 3-mean cluster analysis of the APDI scores.

Type of mantiqas	Average	Min	Max
Low	0.85 (0.80 0.90)	0.35	2.28
Medium	−0.17 (−0.21 −0.13)	−0.66	0.34
High	−1.17 (−1.26 −1.09)	−3.34	−0.67

CI: Confidence intervals for the average are presented between parentheses.

principle component is a linear index of variables with the largest amount of information common to all of the variables according to the following formula.

$$Ij = \sum_{i=1}^{N} \frac{f_i(a_{ji} - a_i)}{S_i}$$

Where f_i is the scoring factor for the ith item as determined by the procedure,

a_{ji} is the *j*th *mantiqa's* value for the *i*th characteristic,
a_i and S_i are the mean and the standard deviation for the *i*th characteristic over all *mantiqas.*

Table 4
Distribution and averages of the variables included in the APDI by types of *Mantiqas*.

Variables	Type of MAntiqa: Low		Medium		High		
No. of *mantiqas*	268		220		146		
Physical characteristic of area							
Area of *mantiqa*	0.41	(0.38 0.43)	0.44	(0.41 0.47)	0.43	(0.40 0.46)	ns
% residential building of total inhabited area	46.35	(44.37 48.36)	25.39	(23.14 27.64)	15.20	(13.23 17.18)	***
% of street area of total area	8.07	(7.84 8.29)	12.55	(12.05 13.04)	19.16	(18.42 19.89)	***
Dominant type of roads narrow	0.99	(0.92 0.97)	0.35	(0.30 0.42)	0.01	(-0.01 0.03)	***
% of garden of total area	0.46	(0.29 0.63)	1.48	(1.09 1.87)	2.39	(1.44 3.34)	***
% of agricultural area of total area	3.75	(2.44 5.05)	2.04	(0.78 3.30)	0.00	(0.00 0.00)	***
% of empty spaces of total area	3.89	(3.00 4.78)	2.48	(1.63 3.33)	0.57	(0.31 0.83)	***
Presence of cemetery area	0.17	(0.12 0.21)	0.1	(0.06 0.14)	0.07	(0.03 0.11)	***
No. of agricultural canal	0.23	(0.16 0.30)	0.07	(0.03 0.11)	0.01	(0.00 0.03)	***
Sources of pollutions							
No. of factories	1.75	(1.26 2.23)	0.66	(0.43 0.90)	0.11	(0.03 0.18)	***
No. of workshops	1.08	(0.88 1.27)	0.35	(0.24 0.46)	0.04	(0.00 0.08)	***
No. of storages	1.79	(1.52 2.05)	0.63	(0.47 0.79)	0.12	(0.05 0.18)	***
Services in the area							
No. of governmental offices	1.45	(1.24 1.67)	1.82	(1.54 2.11)	2.75	(2.17 3.32)	***
No. of banks	0.10	(0.04 0.15)	0.12	(0.04 0.20)	0.59	(0.12 1.06)	***
No. of hotels and motels	0.02	(0.00 0.05)	0.13	(0.04 0.21)	0.77	(0.43 1.11)	***
No. of academic institutes	0.07	(0.03 0.10)	0.20	(0.14 0.27)	0.66	(0.48 0.83)	***
No. of hospitals	0.47	(0.37 0.57)	0.52	(0.40 0.65)	0.90	(0.70 1.11)	***
No. of bakeries	0.65	(0.55 0.75)	0.16	(0.10 0.21)	0.06	(0.02 0.10)	***
No. of entertainment sites (cinemas, theaters)	0.10	(0.06 0.14)	0.25	(0.16 0.35)	1.08	(0.73 1.43)	***
No. of social and sport clubs	0.30	(0.22 0.38)	0.42	(0.33 0.52)	0.91	(0.69 1.13)	***
Presences of security							
No. of embassies	0.01	(0.00 0.02)	0.07	(0.02 0.13)	0.68	(0.24 1.13)	***
No. of military sites	0.24	(0.17 0.30)	0.55	(0.41 0.69)	1.12	(0.90 1.35)	***

***Significant at <0.001.
Confidence intervals for the averages and percentages are presented between parentheses.
"ns" not significant.

APDI: main results

The index

Table 2 presents the results for the first principle component factor analysis. The index ranges between −0.338 and 2.282. The total explained variance for the first component was 49.7%. Since all the characteristics are expressed in a continuous or dichotomous form, the weights are easily interpreted. One unit change in the characteristic changes the index by f_i/S_i, e.g., an increase of 1% in the proportion of the residential building area results in adding 0.007 point to the index value. Presence of cemetery increases the index by 0.088 point.

Testing the reliability and internal coherence of the index

In order to test the reliability of the APDI, it is important to evaluate its performance in differentiating between the different types of *mantiqas*. A 3-means cluster analysis was conducted using the index score as the clustering dimension. Table 3 shows that based on the cluster analysis of APDI index, three statistically significant distinct categories are produced. For the purpose of distinction, these categories will be referred to as low, medium and high, indicating the type of *mantiqa*. Therefore, low is refers to most physically deprived cluster of *mantiqas*, while the high refers to the least deprived cluster of *mantiqas*. The average score for the low cluster was 0.85 with a range from 0.35 to 2.28. The medium *mantiqas* showed an average of −0.17 and ranges between −0.66 and 0.34, while the high *mantiqas* had an average of −1.17 and ranges between −3.34 and −0.67.

To investigate the internal coherence APDI index, Table 4 compares the averages for all variables included in the index across the three types of *mantiqas*. On the one hand, it shows that there no significant differences in the area among the three types. On the other hand, the index produces sharp differences across the three types of *mantiqas* for every variable included in the index. It clearly shows the distinct characteristics of the low cluster compared to the other categories. The low cluster is characterized by high density of residential buildings; low density of streets and gardens; streets that cut across the *mantiqa* are narrow; presence of agricultural area, empty spaces, cemeteries and agricultural irrigation or drainage canals; a large number of factories, workshops, storage buildings, bakeries and a small number of governmental offices, banks, hotels and motels, academic institutes,

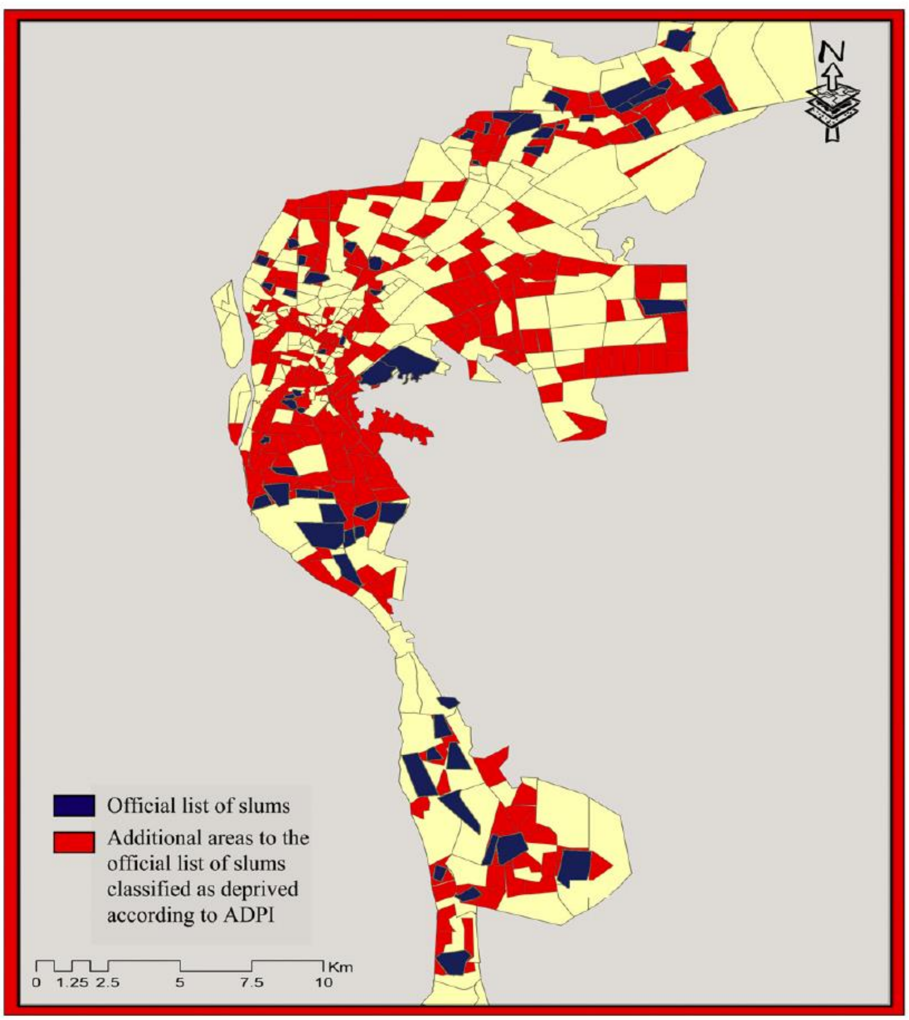


Fig. 2. Comparison between the official list of slum areas in the governorate of Cairo and the deprived area according to APDI.

hospitals, entertainment centers, social and sport clubs, military sites and embassies.

In other words, the low cluster manifests some of the main attributes of slum areas, namely high population density, lack of green areas, the interlock of agricultural and industrial activities with the high density of residential areas; lack of various social; health and entertainment services as well as governmental presence and intense presence of environment pollutant sources, manifested in large numbers of workshops and factories.

Testing the validity of the index

The validity of the proposed index has been tested through two procedures. The first procedure involved the comparison between the official list of slum areas reported by CAPMAS and the list of low *mantiqas*, while the second involved field visits of a random sample of 155 *mantiqas*. This sample represented almost one-fourth of all *mantiqas* in the Cairo governorate.

APDI and official list of slum areas

In this procedure, the official list of slum areas as reported by CAPMAS was compared to the list of low cluster of *mantiqas* as reported by the APDI (Fig. 2). It reveals that APDI has succeeded in identifying all the *mantiqas* officially classified as slums in the Cairo Governorate. In addition, APDI was able to identify more deprived *mantiqas* than the official slum list. Table 5 shows a comparison of the GIS characteristics between the official list of slums and the deprived *mantiqas* that are identified as deprived by APDI but excluded from the official list slums. It reveals that there were no significant differences between the two types of *mantiqas* in any of these characteristics. This table clearly reveals that the APDI was able to capture all the slum *mantiqas* as provided by the official list as well as 225 equally-deprived *mantiqas* as slums in the Cairo governorate.

Table 5
Comparison between the GIS characteristics for both the official list of slum areas and the deprived areas excluded from the official list of slums.

Variables	Official list of Slum areas	Deprived areas not included in official list
No. of mantiqas	43	225
Physical characteristic of area		
% residential building of total inhabited area	43.05	46.99
% of street area of total area	7.49	8.17
Dominant type of roads narrow	0.93	0.95
% of garden of total area	0.33	0.48
% of agricultural area of total area	3.16	3.86
% of empty spaces of total area	2.40	4.17
Presence of cemetery area	0.12	0.18
No. of agricultural canal	0.26	0.22
Sources of pollutions		
No. of factories	1.72	1.75
No. of workshops	1.21	1.05
No of storages	1.98	1.75
Services in the area		
No. of governmental offices	1.77	1.39
No. of banks	0.19	0.08
No. of hotels and motels	0.00	0.03
No. of academic institutes	0.07	0.07
No. of hospitals	0.65	0.44
No. of bakeries	0.81	0.62
No. of entertainment sites (cinemas, theaters)	0.07	0.11
No. of social and sport clubs	0.14	0.33
Presences of security		
No. of embassies	0.00	0.01
No. of military sites	0.33	0.22
Average score for APDI	0.85	0.88
Standard Error DI	(0.38)	(0.41)

Field visits

Data for testing the validity of the APDI index came from conducting field visits and a community survey through which information on the characteristics of a representative sample of *mantiqas* was collected. A sample of 155 *mantiqas* representing almost one-fourth of all (634) inhabited *mantiqas* was visited. These *mantiqas* included 78 low *mantiqas* , 47 medium *mantiqas* and 30 high *mantiqas*. The field work included gathering observations on the various characteristics of the mantiqa including a community observation sheets. These sheets were divided into three main sections: namely neighborhood characteristics, environmental services and social services. The neighborhood characteristics cover description of the conditions of the buildings, main and side roads and streets. Environmental services section addresses the *mantiqa's* access to electricity, safe drinking water and sewage systems and its exposure to other environmental risks. Social services section includes a count of the various social services available in the *mantiqa*, namely educational services, health facilities, access to transportation and other public services.

Results of these field visits showed that low *mantiqas* exhibits significant depletion in their physical structures and more exposure to environmental risks than high *mantiqas* (Table 6). Buildings in low *mantiqas* were more likely to show cracked walls, traces of water leakage, and graphite than both medium and high *mantiqas.* Areas surrounding these buildings had stagnant water and sewage flooding.

Main streets in low *mantiqas* were mostly unleveled or not covered with asphalt and suffer from many obstructions that significantly

Table 6
Main characteristics of Mantiqa by type of the Mantiqa.

	Type of Mantiqa		
	Low	Medium	High
Building			
• Cracked walls***	20.0	4.2	8.1
• Traces of water leakage***	18.2	12.5	2.7
• Graphite on the building walls ***	64.3	33.3	16.2
• Has stagnant water around the dwellings	21.4	25.0	8.3
• Suffer from sewage flooding	21.4	22.9	8.6
Main streets			
• Unleveled and/or un-asphalted***	48.1	25.7	6.2
• Narrow***	22.3	8.9	1.0
• Had obstruction that restricted flow of both cars and pedestrians movements ***	48.2	30.2	16.7
Side streets			
• Unleveled and/or un-asphalted***	40.9	33.3	8.6
• Narrow enough not to allow for any type of traffic flow***	75.7	39.6	20.0
• Narrow enough not to allow for proper ventilation for buildings on its sides ***	45.7	20.8	14.7
Mantiqa in general			
• Empty space turned to dumpsters ***	65.0	36.9	8.9
• Has agricultural plots ***	14.3	10.4	0.0
• Has no green areas or trees***	34.3	12.5	10.8
• Has solid waste (human or animal)***	67.1	39.6	25.0
• Has high voltage towers***	10.1	29.2	8.3
• Has cellular transceiver stations***	40.0	50.0	11.1
• Close to a garbage dump***	50.0	25.0	13.9
• Close to a sanitation dump	5.7	6.3	2.9
• Has a large number of workshop and shops that disturb the residents activities and rest***	85.7	72.3	41.7
• Has piles of dirt and rubbish***	74.3	68.7	30.6
• Has garbage scattered around***	88.6	68.8	38.9
• Has covered or uncovered sewerage outlets	21.4	12.5	8.3
• Has stray animals (cat/dogs)***	82.9	70.8	44.4
• Has places for drug dealing***	34.3	10.4	11.1

***Significant at <0.001.

hinder the smooth flow of both cars and pedestrians. Side streets in these *mantiqas* were also unleveled or not covered with asphalt and, in some cases, too narrow to allow proper ventilation for the buildings on their sides.

Low *mantiqas* were found to encompass a large number of empty spaces that were turned into dumpsters. They lack green areas and parks, and have agricultural plots as well as other environmental risks.

There were no significant differences among the three types of *mantiqas* with regard to their access to environmental services or governmental educational and health services. Furthermore, private and non-governmental services were more common in the low *mantiqas* compared to the high one which might be due to large demand on these services in the low *mantiqas*.

Conclusion

Rapid growth of slums and their detrimental impact on the welfare of their residents have received extensive concerns among national and international developmental agencies, researchers and policy planners. Many agencies and researchers have embarked on developing and setting policies and interventions that aim to secure the welfare of slum dwellers. However, formulating appropriate policies and intervention programs are hampered by the lack of a strong knowledge base on these areas that clearly defines, identifies and signifies the main points of commonality and diversity among these slum areas.

The current study addresses one of the major impediments in building this knowledge base. Absence of a clear operational definition of slum in Egypt called for the development of an index that reflects the physical deprivation in these areas. The current study adopts the new concept of a "deprived area", which refers to areas that lack main physical structures. To tackle the rapid expansion of the deprived areas, the proposed index uses the geographic information system (GIS) and is applied to small geographical areas (*mantiqa*) of size 0.5 km^2. The *mantiqa* acts as base unit for which the information can be updated periodically. Using the most basic GIS layers and the principle component analysis, an index of physical deprivation for these *mantiqas* was constructed. This index allowed the ranking of all the *mantiqas* on their level of physical deprivation as well as the classification of the *mantiqas* into three broad types namely low, medium and high, with the low referring to the most deprived *mantiqas*.

Reliability tests of the index revealed strong and significant internal coherence in which each constituent item of the index significantly differentiate among the three types. Validation tests of the index revealed the ability of the proposed index to capture slums identified by the current governmental official list of slums in addition to other areas that were as equally deprived as the areas included in the official list of slums. Field visits corroborated the significant differences among the three groups of *mantiqas* particularly between the low and high groups with the medium group falling in between the two.

Although the current index has proved its success in differentiating among the clusters of *mantiqas*, we believe that incorporating other layers of information such as data-related connections to general service networks (electricity, water and sewerage) and environmental maps can significantly improve its power in identifying slum and deprived area. Furthermore, in Egypt, CAPMAS is attempting to link census data to GIS. These efforts will deeply enhance the quality of the proposed index as they will expand the concept of deprivation from solely physical to aspect of social deprivation.

References

Abu-Lughod, J. (1981). Strategies for the improvement of different types of low income urban settlement in the Arab region. In *UN Center for human settlement, the residential circumstances of the urban poor in developing countries*. NY: Praeger.

Bayat, A., & Denis, E. (2000). Who is afraid of ashwaiyyat? Urban change and politics in Egypt. *Environment and Urbanization, 12*(2), 185–199.

Central Agency for Population Mobilization and Statistics (CAPMAS). (2008a). *General census of population, housing and buildings 2006: Final results*. Cairo: Central Agency for Population, Mobilization and Statistics.

Central Agency for Population Mobilization and Statistics (CAPMAS). (2008b). *Statistical year book 2007.* Cairo: Central Agency for Population, Mobilization and Statistics.

Denis, E. (1997). Urban planning and growth in Cairo. *Middle East Report, 27*(1), 7–12.

Dorman, W. 2007. The Politics of Neglect: the Egyptian State in Cairo 1974–1998. Ph.D. dissertation. School of Oriental and African Studies, University of London Available online at http://eprints.soas.ac.uk/155/1/Dorman_Politics_of_Neglect.pdf.

El Araby, M. (1994). Impacts of rent control upon housing stock and benefits distribution in Egypt: a reference to deterioration of residential buildings. *Architectural Scientific Journal, 8*, 118–134.

El Araby, M. (2003). The role of the state in managing urban land supply and prices in Egypt. *Habitat International, 27*, 429–458.

El Batran, M., & Arandel, C. (1998). A shelter of their own: informal settlement expansion in Greater Cairo and government responses. *Environment and Urbanization, 10*(1), 217–232.

Fahmi, W., & Sutton, K. (2008). Greater Cairo's housing crisis: contested spaces from inner city areas to new communities. *Cities, 25*, 277–297.

Harris, R., & Wahba, M. (2002). The urban geography of low-income housing: Cairo (1947–96) exemplifies a model. *International Journal of Urban and Regional Research, 26*(1), 58–79.

Ibrahim, M., 2009. Towards Reliable Spatial Database of Informal Areas in Greater Cairo Region. Paper presented at the International Workshop on Spatial Information for Sustainable Management of Urban Areas FIG Commission 3 Workshop, Mainz, Germany, 2–4 February. Available online at: http://www.fig.net/commission3/mainz_2009/programme2-Dateien/TS%209.2_Ibrahim%20Informal%20areas%20in%20GCR.pdf.

Mayo, S. K. (1982). *Informal housing in Egypt*. Cambridge MA: Abt Associates.

Nedoroscik, J. (1997). *The city of the dead: A history of Cairo's cemetery communities*. Westport, Conn: Bergin and Garvey.

Rugh, A. (1979). *Coping with poverty in a Cairo community. Cairo papers on social science 3*. Cairo: American University in Cairo Press.

Shoura Council. (2009). *Informal settlement in greater Cairo*. Cairo, Egypt: Shoura Council Press (in Arabic).

Sims, D. (2003). The case of Cairo, Egypt. In *UN habitat, global report on human settlements 2003, the challenge of slums*. London: Earthscan.

Singerman, D. (1995). *Avenues of participation: Family, politics and networks in urban Quarters of Cairo*. Princeton, NJ: Princeton University Press.

Soliman, M. (1995). A tale of informal housing in Egypt. In B. C. Aldrich, & R. S. Sandhu (Eds.), *Housing the urban poor: Policy and practice in developing countries*. London: Zed Books.

Turkstra, J., 2008. Visible and non-visible slum, Libya and Somalia. Paper presented at the Expert Group Meeting on Slum Mapping at ITC in Enschede Netherlands, 21–23May. Available online at http://www.ciesin.columbia.edu/confluence/download/attachments/34308102/Turkstra+EGM+Slum+mapping+ITC+21-23+May+2008.pdf?version=1.

UN Habitat. (2003). *The challenge of slums – UN HABITAT's global report on Human settlements*. New York: Population Division, Department of Economic and Social Affairs, United Nations.

UN Habitat. (2006). *The state of the World cities 2006/2007: The Millennium development goals and urban sustainability, 30 Years of shaping habitat agenda*. New York: Population Division, Department of Economic and Social Affairs, United Nations.

UN Habitat. (2008). Background for the expert group meeting on slum identification /mapping using geo-information technology. Available online at http://itc.eu/news_events/archive/general/_doc/Expert%20meeting%20on%20slum%20identification%20Final.pdf.