



# Knowledge and perspectives of the public towards the prevalence and harm associated with counterfeit medicines in Lebanon

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## ABSTRACT

The Knowledge about the use of counterfeit medicines in Lebanon is still very limited. Thus, the objective of this study was to evaluate the degree of awareness of counterfeit medicines among the Lebanese population and the harm associated with their consumption. A cross-sectional study based on a questionnaire survey has been applied where a semi-structured survey questionnaire was distributed, between June 2017 and May 2018, among 750 participants from 98 Lebanese areas to assess their awareness regarding counterfeit medicines. Seven hundred and four participants completed the questionnaire. 55.4% purchased medicines regularly. The main sources of medicines were pharmacies (52.6%), government clinics (16.3%) and private clinics (8.7%). The most common purchased medicines were lifesaving ones (80%). In the majority of cases (71.9%), participants could not identify the manufacturer country. Overall, 46.2% of the participants were aware of counterfeit medicines. 5.4% of the participants experienced self-reporting adverse effects, among which 89.5% of cases were reported to pharmacists or other authorities. Despite the risk, 4.7% of participants were willing to buy a potential counterfeit medicine. In fact, 56.4% of the participants associated low harm level with the use of counterfeit medicines. Despite their awareness of counterfeit drugs-associated risks, the majority of participants tend to buy them again. Informative public health campaign and health professionals training, to prevent counterfeit medicines-associated harms, should be implemented.

## Introduction

Counterfeiting is the act of deliberately imitating an original product with a purpose to steal, to destroy, or to replace the original product for use in illegal transactions as well as to deceive and to dupe the customer into believing that the fake merchandise are of equal or greater value than the real one. Counterfeit medicines represent a public health threat and are often associated with long-term consequences including cancer and heart disease (Jung, 2007). Medicine counterfeiting has been identified by the World Health Organisation (WHO) as an international problem back in 1985. Accordingly, the WHO and the Food and Drugs Administration (FDA) identifies a counterfeit medicine by presenting at least one of the following criteria: (1) contaminated sample; (2) containing the wrong active pharmaceutical ingredient (API); (3) formed without an API; (4) have the right API but with wrong quantity; (5) and/or have the wrong excipients (Perera et al., 1996; WHO, 2018). Medicine counterfeiting is not limited to defects in chemical constituents

but also include falsified physical characteristics such as a wrong packaging or a forged documentation or labeling of the box and the leaflet. Although medicine counterfeiting is more common in countries with poor regulatory or enforcement regimes, certain developed countries are even witnessing the spread of that phenomenon and that might be due to a weakness in their enforcement aspect. In January 2016, the WHO agreed to adopt the term “substandard and falsified (SF)” medical products for those currently known as “substandard/spurious/falsely-labeled/falsified/counterfeit (SSFFC)” medical products. In fact, the substandard products, (designated “out of specification”) are authorised medical products that fail to meet either the quality standards or specification or both. However, the counterfeited medication is neither regulated nor quality controlled.

Medicine counterfeiting is not exclusive to a certain pharmacological class. It spans both lifestyle and lifesaving medicines such as: antibiotic (Delepiere et al., 2012), antidiabetics (Yao et al., 2007), anxiolytics (CC., 2019), cardiovascular (Antignac et al., 2017), sexual stimulants (Jackson et al., 2010) and weight loss products (Malet-Martino and Martino, 2015). Lifestyle drugs are more prone to falsification. Lifestyle drugs are considered to be the drugs that are used to treat none threatening and none painful cases such as baldness, wrinkles, impotence or acne

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that are perceived as a minor medical problem relative to others. Even though some lifestyle medications can help in improving our health but they are not considered curative or lifesaving as a patient's life won't be at risk if they did not use or consume it.

In 2017, the WHO estimated that 10.5 % of medicines around the world were substandard or falsified (WHO, 2017). A systematic review in 2018 shed light that the prevalence of substandard and falsified medicines (based on published surveys between 2007 and 2016) was 13.6% in low-and middle- income countries with an overall regional prevalence of 18.7% in Africa and 13.7% in Asia. In this perspective, the estimated economic impact extended widely from \$10 billion to \$200 billion (Ozawa et al., 2018; WHO, 2017).

In 1982, and during the civil war, 57 different medicines were reported, in Lebanon, as counterfeit (Sholy et al., 2018). Subsequently, governmental controls became obligatory where each medicine must now be registered and approved by the Ministry of Public Health (MoPH) before distribution to the market (MOPH). In 2004, 3D holograms to test imported drugs' authenticity were put in place and have been used since (MOPH, 2012). The 3D hologram is a security feature tagged on the product. It is mainly used to prevent counterfeiting and it is constituted by a visual authentication. This latter is extremely difficult to be copied since it is fabricated from a type of display using light diffraction generating three-dimensional image pattern. Despite its importance and immense impact on public health, studies evaluating pharmacists and public knowledge about counterfeit medicines are limited (Shahverdi et al., 2012, Ivanitskaya et al., 2010, Assi et al., 2016, Lybecker, 2007, Pál et al., 2015, Desai et al., 2015, Tipke et al., 2008, Sengaloundeth et al., 2009).

Medicines in Lebanon are only found in pharmacies and dispensed by registered pharmacists. Counterfeiting medicines encountered in Lebanon were reported in several studies. In 2010, it was reported that nine pharmacies and four warehouses were closed for possessing counterfeit Plavix (clopidogrel) where the boxes held the official hologram while their security label was counterfeit (Sholy and Saliba, 2018). In a study done in 2018 showed the statistical extent of counterfeited drugs in some Lebanese regions. The study showed that 4% of counterfeiting is found in Mount Lebanon, 12% in the South and Bekaa (Sholy and Saliba, 2018). The previous study mentioned, recruited more numbers of participants for about 849 whereas the present study included 704 candidates. Unfortunately, there is a lack of studies related to medicinal counterfeiting in Lebanon. Some surveys have been made to assess the awareness of Lebanese pharmacists and views towards falsified medications. According to a survey made in 2011, the results showed that most of the interviewed correlates counterfeit medications to being a bad quality medication or one of an unknown source. The interviewed were aware of some pharmacists dispensing counterfeits and considered them unprofessional and unethical (Sholy et al., 2018). They also believe in strengthening the legislations against counterfeiting. Moreover, it was noticed that pharmacists in the Bekaa region were least likely to report knowing about pharmacists dispensing counterfeits and this is either due to their lack of knowledge or due to a link to organised crimes (Sholy et al., 2018). The main contributing factors in increasing counterfeits in Lebanon are the lack of awareness of the pharmacists and the consumers for a counterfeit reporting system. The increase in the number of graduating pharmacists in contrast to a decrease in the minimum wages. The corruption that increases the prevalence of falsified medications in the trade causing a mistrust of the healthcare system. Last but not least, the shortage of medications that leads to an increase in the demand of cheaper drugs that are most likely to be falsified (Sholy et al., 2018).

This work is based on a questionnaire survey designed to evaluate the knowledge of Lebanese people and their perceptions concerning prevalence and harm associated with counterfeit medicines. In addition, the questionnaire explored the prevalence of counterfeits per the major Lebanese districts specifically Bekaa, Mount of Lebanon, Nabatyeh, North and South of Lebanon.

## Methods

### Study design

To further assess the Lebanese public health knowledge and awareness on the prevalence of counterfeited medication and its harmful side effect, a cross sectional study has been employed using a questionnaire survey. The survey design was based on a study previously conducted in the United Kingdom concerning purchasing medicinal and lifestyle products (Assi et al., 2016). It has been modified and adapted according to the country's aspects and the targets of the study. All procedures performed in studies involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments. Prior to completion of the questionnaire, the participants were supplied with a study information leaflet and a consent form. The study information leaflet explained the aim and the objectives of the research and the outcomes sought behind conducting it. Participants were also made aware of their right to withdraw from completing the questionnaire at any stage. No personal or identifiable data was collected. The questionnaire was piloted by two persons respecting the national guidelines for researchers in Lebanon in terms of transparency, objectivity, precision, confidentiality, strict adherence to the "International Declaration of Human Rights".

### Questionnaire development

As reference, a previous questionnaire used by Bournemouth University was used as a guideline to construct our form (Assi et al., 2016). The questionnaire was composed of 37 questions and divided into five parts (Table 1): (I) demography of participants, (II) extent of buying medicines, (III) types of purchased medicines, (IV) awareness of counterfeit medicines and (V) awareness of adverse events associated with counterfeit medicines. Respectively, the first part of the survey covered the demographic information specifically gender, age, nationality, spoken language(s), education level and job. The second part explored the aspects applied for buying medicines in terms of the regular purchase of medicines, the sources of information about medicines awareness, the medicines purchase places, the country of origin and the authenticity identification. The third part of the survey assessed the most used and bought medicines in Lebanon. The fourth part of the survey is related to the awareness of the consumer on (1) counterfeit medicines, (2) the manner in which a medicine's originality is checked. Furthermore, the latter section included whether the participants have ever encountered any counterfeit medication and if the case was reported to the specialised authority. The final part inspected the awareness of the participants on the adverse consequences resulted by counterfeit medicine usage. In fact, we have asked the participants whether they have experienced any adverse events as a result of using a potential counterfeit medicines and describing the effects. Participants were also questioned if they accepted to take the risk of buying counterfeit medicines. In the end of the questionnaire, an evaluation on a scale of 1 to 10, was provided to establish the extent of the participants' belief to the harm associated with counterfeit medicines.

### Data collection

Prior to distribution, the questionnaire was piloted for 30 medicines' users in order to insure face and content validity. The opinions of the participants were considered and the necessary changes, in terms of the structure and the content of the questions, were adequately altered in the questionnaire.

The questionnaire was disseminated over approximately one year between June 2017 and May 2018. The survey was mainly performed in pharmacies where 750 copies of the questionnaire were prepared and an copy was shown for all buyers who accepted to take part in the survey. The participants reflected the demography of the people visiting

**Table 1**  
The survey design.

Part	Aims
Demography	Sociodemographic factorsEconomic factors
Extent of buying medicines	Frequency of buying medicinesSources of informationSources of bought productsCountry of medicines manufacturer
Types of purchased medicines	Medicinal productsHerbal, supplements and cosmetics products
Awareness of counterfeit medicines	Knowledge on counterfeit medicinesSources of knowledgeCriteria to check medicines' authenticityEncounter counterfeit medicines
Awareness of adverse effects of counterfeit medicines	Opinion about the risk to buy unlicensed medicinesExperience with adverse effects associated with using a counterfeit medicineType of adverse effectsDegree of harmReporting the adverse effect to an authority

the pharmacy. In addition, the survey included participants from different Lebanese districts specifically Bekaa, Mount of Lebanon, Nabatyeh, North and South of Lebanon. 704 individuals took part in the survey. Subsequently, the data obtained was meticulously scrutinised by two authors (M.N. and S.A.) and the scripts were examined for missing data or ambiguous information. Finally, 704 questionnaire data were included. Prior to completion of the questionnaire, the participants were supplied with a study information leaflet and a consent form. The study information leaflet explained the aim and the objectives of the study and the outcomes sought behind conducting it. The participants were also made aware of their right to withdraw from completing the questionnaire at any stage. No personal or identifiable data was collected.

Thus, the data collection process was conducted on 704 participants between June 2017 and May 2018 covering 98 cities and villages within Lebanon. Eligible participants were residing in Lebanon, aged above 18 years old and understood Arabic and/or English. The questionnaire was piloted by two persons respecting the national guidelines for researchers in Lebanon in terms of transparency, objectivity, precision, confidentiality, strict adherence to the "International Declaration of Human Rights" (Hamze et al., 2016). The questionnaire was distributed anonymously and the selection of participants was done randomly with no personal identifiable information. Additionally, the survey was written in English and a translation for the questionnaire and the participants' answers were accomplished when participants can only speak Arabic or French. The survey was executed with a face-to-face contact where each one lasted for 15-25 minutes with voluntary participation. The samples were chosen to be a representation of the entries' country population based on the gender, the education and the geographical differences. However, more focus was directed into Beirut city due to the high population density.

#### Statistical analysis

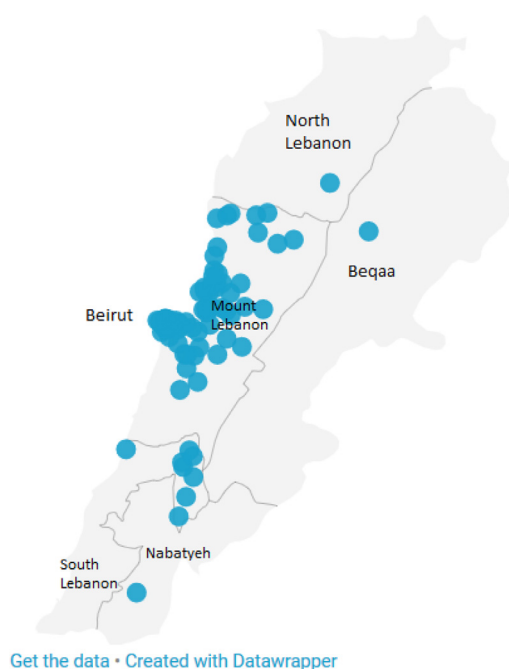
Data were entered manually into SPSS version 24. Variables were then coded and numbered prior to data analysis. Data were summarised using frequency and percentages. In this study, we were interested in statistical information (frequency (%)) regarding the demographic characteristics of the participants, the participants' extent on buying medicines, the main purchased medicinal classes, the knowledge of participants regarding counterfeit medicines and finally the participants' behavior towards counterfeit medicines.

## Results

Out of 750 invitations, a total of 704 participants completed the survey and were all included in the study (93.87%). The participants were spread over five main Lebanese governorates being: Bekaa, Mount of Lebanon, Nabatyeh, North and South of Lebanon (Fig. 1).

#### Demographic characteristics of the participants

The response rate was similar among males and females corresponding to 53.1% and 46.2%, respectively (Table 2). Participants' age range was equally distributed among the different age groups with a mean age of  $33.5 \pm 7$ . The majority of the participants had a Lebanese nationality



**Fig. 1.** Questionnaire distribution. The map was created using the Datawrapper website.

(84.8%). The educational level of the contributors was between school level (46.6%) or University Bachelor level (36.9%) and they spoke more than one language (70.5%). When asked about their occupation, more than half of the participants had jobs in retail (such as shops and stores).

#### Participants and medicines

Only 14.5% of the participants reported purchasing medicines regularly, whereas, 17.8% and 21.2% of the participants reported purchasing medicines occasionally or rarely respectively (Table 3). The main medication sources were pharmacies (52.6%) followed by governmental clinics (16.3%). Other sources including private clinics, hospitals, the Internet, gyms and relatives from other countries were below 10% each. Only 24.4% of the participants could identify the manufacturing source of the medicine purchased. Once identified, manufacturing sources included Europe (25.7%), USA and Canada (9.38%) and the Middle East (10.4%). More than half of the participants were not aware of specific markers to check the medicines' authenticity. Participants often followed doctors' recommendation for choosing the specific medicine brand and referred to doctors when seeking information about medicines.

#### Main medicines classes purchased by participants

Participants reported the purchase of both lifesaving and lifestyle medicines equally (around 80%). The most purchased drugs were anti-asthmatic and cardiovascular medicines that represented 22.3% and

**Table 2**  
Demographic characteristics of the participants.

Characteristic	Frequency (%)
Gender	
Male	374 (53.1)
Female	325 (46.2)
Prefer not to say	5 (0.7)
Age (years)	
18-25	130 (18.5)
26-33	196 (27.8)
34-41	181 (25.7)
>42	194 (27.6)
NR	3 (0.4)
Nationality	
Lebanese	594 (84.4)
Syrian	45 (6.39)
Iraqi	18 (2.56)
Egyptian	12 (1.7)
Indian	10 (1.42)
Other nationalities	25 (3.55)
Language(s) spoken	
Arabic only	146 (20.7)
Arabic and English	188 (26.7)
Arabic and French	114 (16.2)
Arabic, English and French	194 (27.6)
Other languages (not specified)	62 (8.8)
Educational level	
High school/college	328 (46.6)
Bachelor	260 (36.9)
Masters or equivalent	95 (13.5)
PhD	6 (0.9)
NR	15 (2.10)
Occupation	
Retail	57 (8.46)
House wife	41 (6.08)
Teacher	37 (5.49)
Managerial	33 (4.9)
Hospitality	26 (3.86)
Taxi or bus driver	25 (3.71)
Bakery	21 (3.12)
Governmental organisation	21 (3.12)

Other nationalities were reported below 1% each and included African, Ethiopian, Indonesian, Japanese, Jordanian and Sri Lanka.

21%, respectively (Table 4). This was followed by weight loss products (15.8%), dietary supplements (14.1%) and sleep aids (13.2%). Moreover, antidiabetic and antidepressant drugs accounted for 11.2% and 9.38% respectively. Other medicines included skin products, hair care products, image enhancers and sexual stimulants, were purchased by less than 1% of participants.

#### Knowledge of participants regarding counterfeit medicines

Participants were split almost in equal proportion when asked about awareness regarding counterfeit medicines (Table 5). In this respect, 46.2% of participants were aware of counterfeit medicines, 46.4% were not aware whereas 7.4% did not answer. However, only 5.7% of participants encountered a counterfeit medicine and only 3.8% reported it to the authorities. Most of the participants (92.9%) did not identify any health triggers that indicated the use of a counterfeit medication whereas only 5% of participants indicated that the presence of an adverse effect had been an indication of the use of counterfeit medicine. The self-reported encountered adverse effects included cardiovascular consequences, fever and allergy. *Experience of adverse effects associated with counterfeit medicines' use*

Only 38 participants (5.4%) experienced adverse effects and associated it with the use of a counterfeit medicine (Table 6). Once reported, the aforementioned effects included allergy, fever and vomiting. 34 participants (4.83%) reported the adverse effects to the authorities or pharmacists. In addition, participants stated taking antibiotics or antiallergic agents to counteract the aforementioned adverse effects. When asked

**Table 3**  
Participants and medicines.

Participants extent of buying medicines	Frequency (%)
<b>Frequency of purchase of medicines</b>	
Regularly	102 (14.5)
Occasionally	125 (17.8)
Rarely	149 (21.2)
NR	328 (46.6)
<b>Medicines purchase sources</b>	
Pharmacies	370 (52.6)
Governmental clinics	115 (16.3)
Private clinics	61 (8.7)
Hospitals	62 (8.8)
Others*	9 (1.28)
NR	87 (12.4)
<b>Information availability regarding the manufacturing source</b>	
Yes	172 (24.4)
No	506 (71.9)
NR	26 (3.7)
<b>Manufacturing sources of medicines</b>	
Europe	181 (25.7)
USA and Canada	66 (9.38)
Middle East	73 (10.4)
South America	2 (0.28)
Asia	2 (0.28)
Australia	2 (0.28)
Russia	2 (0.28)
NR	376 (53.4)
<b>Sources of information about medicines</b>	
Doctors	413 (58.7)
TV and magazines	153 (21.7)
Events	133 (18.9)
Others* b	5 (0.71)
<b>Awareness of specific marker indicating medicine authenticity</b>	
Yes	288 (40.9)
No	385 (54.7)
NR	31 (4.4)
<b>Seeking doctor's advice for choosing the medicine brand</b>	
Yes	462 (65.6)
No	224 (31.8)
NR	18 (2.57)

\* Others include internet, Overseas and Gym\* Others b include family and friends, brochures charities, gym and NGOs

**Table 4**  
Main medicine classes purchased by participants.

Medicine class	Frequency (%)
Antiasthmatic	157 (22.3)
Cardiovascular	148 (21)
Weight loss products	111 (15.8)
Dietary supplements	99 (14.1)
Antidiabetic	79 (11.2)
Sleep aids	93 (13.2)
Antidepressants	66 (9.38)

about the harm resulting from counterfeit, 53.02% of participants believed that counterfeit medicine has severe and harmful consequences. Despite awareness of harm associated with counterfeit medicines, 4.69% of participants believed that it was acceptable to buy a falsified drug in cases of medicine shortage or of cheaper prices.

#### Discussion

The current survey is the first study to provide comprehensive examination and analysis of public knowledge and perspectives in relation to the prevalence and harm associated with counterfeit medicines among the Lebanese public. In the preceding years, only few published studies have examined pharmacists' awareness and observations towards counterfeit medicines (Sholy et al., 2018, Sholy and Saliba, 2018, Sholy et al., 2018) but without looking into the perspectives and expe-



**Table 5**  
Knowledge of participants regarding counterfeit medicines.

Characteristic	Frequency (%)
<b>Awareness of a counterfeit medicine</b>	
Yes	325 (46.2)
No	327 (46.4)
NR	52 (7.4)
<b>Encounter of a counterfeit medicine</b>	
Yes	40 (5.7)
No	654 (92.9)
<b>Reporting of an encountered counterfeit medicine to authorities</b>	
Yes	27 (3.8)
No	29 (4.1)
NR	648 (92.1)
<b>Method of checking medicine authenticity</b>	
Asking a doctor	246 (34.9)
Asking a pharmacist	129 (18.3)
Checking medicine tag	63 (8.9)
Checking medicine barcode	56 (8)
NR	210 (29.8)
<b>Indications that triggered the presence of a counterfeit medicine</b>	
Encountering an adverse effect	35 (5)
Appearance of the product	9 (1.3)
Different package	3 (0.4)
Different label	3 (0.4)
NR	654 (92.9)
<b>Adverse effects attributed to counterfeit medicines</b>	
Cardiovascular problems	70 (9.9)
Fever	45 (6.4)
Allergy	44 (6.3)
Brain damage	41 (5.8)
Vomiting	32 (4.5)
Liver damage	20 (2.8)
Death	16 (2.3)
Coma	11 (1.6)
Others	32 (4.54)
NR	393 (55.8)

rience of the patients. The size (704 participants), distribution (98 cities over the country), range of age groups (18-42+) and quasi equality between males and females among the surveyed sample are suggestive that this survey is a strong reflection/representation of the views of the general public in Lebanon. In this survey, respondents' level of education was significantly higher than the average literacy level in the country. This higher education level might be linked to increased access to information and professionals (e.g. doctors and pharmacists); in turn raising awareness and cautiousness in the accredited sources (Włodarczyk et al., 2017). Contrastingly, an insignificant percentage of participants were reliant upon television and magazines for knowledge. Effective communication between patients, healthcare providers and medicines suppliers was identified as significantly impacting patient treatment, and was associated with a lowered risk of purchasing counterfeit medicines (Blackstone et al., 2014). However, as the majority of the participants did not demonstrate any commitment or preference to visit the same pharmacy/pharmacist for services, it was suggested that, potentially, a lower degree of patients' counselling and education would take place, due to a lack of patient-professional relationship and continuity (O'Neil and Poirer, 1998).

Additionally, it is noteworthy that the main source of medicines purchased by regular patients (>50%) were pharmacies, hospitals, government and private clinics (86.4%). Despite this, participants' awareness of counterfeit medicines was identified to be 46.2%. This is indicative of a negative perception/experience to professional healthcare providers who deal with eliminating counterfeited medications from the legitimate supply chain (Sholy et al., 2018, Alfadi et al., 2014). As opposed to providing safe and effective medicines, which would foster trust, the supply of counterfeit medicines has cast doubt and caused damage to the professionalism and credibility of healthcare professionals working in the pharmacy practice or healthcare sector (Shahverdi et al., 2012, Sholy et al., 2018, Abu Taleb and Al Madadha, 2013). The previous ap-

**Table 6**  
Participants behaviour towards counterfeit medicines.

Characteristic	Frequency (%)
<b>Experience of adverse effect due to a potential counterfeit medicine</b>	
Yes	38 (5.4)
No	660 (93.8)
NR	6 (0.85)
<b>Characteristic of adverse effect attributed to a counterfeit medicine</b>	
Allergy	14 (1.99)
Fever	9 (1.28)
Vomiting	9 (1.28)
Different from effects on label claim	22 (3.13)
<b>Adverse effects reported to pharmacist or authority</b>	
Yes	34 (4.83)
No	657 (93.3)
<b>Medicines often taken to counterfeit adverse effects associated with counterfeit medicines</b>	
Antibiotics	14 (1.99)
Antiallergic	8 (1.14)
Other	10 (1.42)
<b>Degree of harm attributed to counterfeit medicines</b>	
1	24 (3.41)
2	47 (6.68)
3	80 (11.4)
4	82 (11.7)
5	98 (13.92)
6	65 (9.23)
7	116 (16.5)
8	128 (18.2)
9	58 (8.1)
10	7 (0.99)
<b>Acceptability of buying a counterfeit medicine</b>	
Yes	33 (4.69)
No	667 (94.7)
NR	4 (0.57)
<b>Reason for acceptability of buying a counterfeit medicine</b>	
Lower price	21 (63.6)
Medicine shortage	6 (18.2)
Trying something new	2 (6.06)
Hatred for medicines	1 (3.03)
Good efficacy	1 (3.03)
NR	2 (6.06)

proach adopted by some healthcare professionals, may negatively impact the reputation of pharmacists simply by association through title and profession (DiPiro, 2011). However, in the presence of a close professional relationship between patients and pharmacist, a reduction in the chances of exposure to counterfeit medicines may be achieved. As pharmacists are the last point of patient contact, they are in an ideal position to educate patients on identifying counterfeit medicines, and increasing awareness of the potential risks associated with their use or consumption (Barrett and Al-Mousawi, 2018). Despite the high level of education, it was surprising to note that approximately 75% of participants did not identify or pay attention to the country of origin of medicines. This could be related to the lack of reading, culture and/or the fast pace of life (Sholy, 2015).

Regarding the medicines manufacturing sources, many were found to originate from France, the UK and the USA. It was also reported that circa 30-40% of all medicines supplied to some parts of the Middle East are counterfeit (El-Jardali et al., 2015). Thus, it is crucial to identify counterfeit medicines at entry ports, by robust drug registration system via government agencies. Drugs' entry can be controlled by trained pharmacists who can recognize falsified or non-WHO certified medicines (Hamilton et al., 2016, El-Jardali et al., 2016). Approximately 3.6% of the medicines were fabricated in Lebanon, indicating a recognizable improvement of the national drugs manufacturing, and was conveyed in a report about the analysis of Lebanon's pharmaceutical market in 2014 (Soueid et al., 2014). Our data demonstrated that majority of participants purchased lifesaving medicines as opposed to lifestyle medicine.

For lifesaving medicines, anti-asthma products were mainly purchased with 22.3%. This proportion may be explained by the increase

of atmospheric pollution and the recent increase in household waste in Lebanon (Abdallah et al., 2018, Tiotiu et al., 2020). Cardiovascular diseases accounted for the highest percentage (21.02%) of adverse effects; cardiovascular diseases are mainly attributed to obesity, smoking and blood pressure complications (Deek, 2016). A further identified factor was high stress levels associated with the socio-economic status of Lebanese people. Lifestyle products (e.g. skin and physical appearance products) were the most purchased items, constituting around 80% of the survey participants' purchases, which could be explained by the well-known interest of Lebanese people in the cosmetics sector.

A minor percentage of counterfeit cases were reported to the authorities. Merely 4.83% of adverse effects cases caused by counterfeit medicines were reported to pharmacists and authorities, where 46.2% of participants were aware of counterfeit medicines. Consequently, it is of great importance to propose the subject of how and why suspected counterfeit medicines need to be reported. The lack of awareness and understanding of counterfeit medicine related risks and the absence of counterfeit medicine reporting systems in Lebanon was also addressed by Sholy, Gard (Sholy et al., 2018). A strategic plan reporting counterfeit medicines to a trustworthy pharmacist who is accessible and easy to communicate with (Sholy et al., 2018, Barrett and Al-Mousawi, 2018, Criddle, 2013).

Another major discussion point of the present research is that despite high level of education, participants were willing to buy counterfeit medicines (less than 5%) due to their lower price and stated medicine shortages as a driving factor underlying this behavior. Sholy and Saliba (Sholy and Saliba, 2018) previously reported that participants' positive perception towards counterfeit medicines increased due to the unaffordability and inaccessibility of original medicines. Participants also held the belief that original medicines are superior to counterfeit medicines (Celso et al., 2007, Penz and Stöttinger, 2008, Commuri, 2009). However, the attractive low prices may compensate for the lower efficacy and quality when people have a limited budget (Sholy et al., 2018, Ang et al., 2001). Reduced prices of counterfeit medicines can be an attractive alternative to those with low socio-economic status, particularly when the risk is very low or unknown (Sholy et al., 2018, Alfadl et al., 2014). In developing countries, the public is less concerned and contribute greatly towards counterfeit medicines (Alfadl et al., 2012).

This study demonstrated that a continuous educational campaign should be provided by the Ministry of Public Health in order to emphasize the risk and consequences associated with counterfeit medicines, as well as highlighting the role of the healthcare sector to provide awareness and prevent the use of counterfeit medicines. Thus, greater awareness will reduce the chances of counterfeit medicines use.

### Limitations

Even though this study covered many regions in Lebanon from North to South, more participants from additive regions are needed. Only five main governorates were covered due to time restriction. Moreover, some participants were poorly educated towards the use of medication, and could not understand the efficacy of this survey nor comprehend the importance of acquiring their responses. Thus, more participants were interviewed but not all taken into consideration in this survey. Likewise, we need to bring the attention that there was no way to authenticate causality, the adverse reactions were self-reported by the users

### Recommendations

This study was mainly done to reflect peoples' knowledge for counterfeit medications and subsequently grow their awareness through different steps:

- A novel policy should be implemented in all pharmacies and drug stores to organize the patient-pharmacist relationship according to professional standards.

- A drug registration system controlled by pharmacist is of main importance to control medications import and limit the reception of counterfeit medications: pharmacists should be trained and selected by the government.
- Last but not least, specialists and associations should organize campaign for the public to raise people's awareness over counterfeit medications and prompt them to report any kind of adverse effect due to counterfeit medications.

### Conclusions

Our study is the first to examine the knowledge and perspectives of the Lebanese public towards the prevalence and harm associated with counterfeit medicines. Although the use of medicine is widespread across the country, especially for lifesaving drugs, the majority of the sample relied on their doctors and pharmacists to check the originality of such products as they were unable to do so and considered this an issue of concern. Overall, the perception of risk was minimal, despite some reported side-effects, and the scarcity of reported problems to authorities. Not only further studies evaluating both the pharmacists and the public knowledge and perception are needed, but also informed public health campaign and training for health professionals should be implemented in the country to prevent the harms associated with the unwanted use of counterfeited products, which are becoming increasingly available in a globalized society.

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### Ethical approval

All procedures performed in studies involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments.

### Informed consent

Informed consent was obtained from all individual participants included in the study.

### Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### CRedit authorship contribution statement

**Manale Noun:** Conceptualization, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration, Funding acquisition. **Layla Nasr:** Conceptualization, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization. **Iftikhar Khan:** Conceptualization, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization. **Basel Arafat:** Conceptualization, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization. **Sulaf Assi:** Conceptualization, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision.

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## Appendix: The Questionnaire

### Introduction

Therefore, the aim of this questionnaire is to investigate the sources and extent of purchase of medicines over the wholesale supply chain, the main medicine classes purchased and the public awareness of counterfeit medicines as well as potential harm resulting associated with the use of counterfeit medicines.

Your participation is entirely voluntary. There is no right or wrong answer and I am interested in your own personal experiences and point

### Part I: Demography

Please select your age range

☐ 18-25 ☐ 26-33 ☐ 34-41 ☐ 42+

What is your gender?

☐ Male ☐ Female

What is your nationality?

Which city of Lebanon do you reside?

What language(s) do you speak?

What is your education level?

☐ School/College ☐ Bachelors  
☐ Masters/postgraduate ☐ PhD+

If you are studying, what is your course?

What is your job?

### Part II: Extent of Buying Medicines

Do you purchase medicines regularly?

☐ Yes ☐ No

If yes, what sources do you get the information about your medicines?

☐ Healthcare ☐ TV/magazines  
☐ Family/Friends ☐ Other (Please state):

If yes, how often do you buy medicines?

☐ Rarely ☐ Occasionally ☐ Always

Where do you get your medicines from?

☐ Pharmacies ☐ Government Clinics  
☐ Other Clinics ☐ Hospitals  
☐ Internet/phone/Other (Please Specify):

Is the country of origin of the medicine identifiable?

☐ Yes (Please Specify) ☐ No

If you buy from the internet, what country do they originate?

Is there any specific badge or mark that indicates the authenticity of the medicine?

☐ Yes ☐ No

Do you speak to a doctor to seek advice regarding buying the brand of medicine?

☐ Yes ☐ No

### Part III: Types of Medicines Bought

What types of medicines do you buy?

☐ Cardiovascular ☐ Diabetes  
☐ Anticancer ☐ Antipsychotic  
☐ Antiasthma ☐ Herbal Products  
☐ Herbal Products and supplements  
☐ Other (Please Specify):

Which of these medicines did you buy?

Cognitive Function:

☐ Caffeine ☐ Memory Enhancers  
☐ Nootropics ☐ Other (Please Specify):

Mood and Social Behaviour:

☐ Antidepressants ☐ Mood Enhancer  
☐ Sleep Aid ☐ To Get High  
☐ Other (Please Specify):

Sexual Stimulants:

☐ Condoms ☐ Herbal Products  
☐ Libido Enhancers  
☐ Synthetic:  
☐ Viagra ☐ Cialis ☐ Levitra  
☐ Other (Please Specify):

If yes, how did you identify it?

☐ Appearance/ ☐ Packaging  
☐ Label ☐ Side Effects  
☐ Other (Please Specify):

of views. The identities of all participants will remain strictly confidential and it will not be possible to identify any individual. The overall aim of the study is to make recommendations to reduce the risks resulting from the use of lifestyle products. This questionnaire should take around 15 minutes.

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