INTRODUCTION

It is generally known that cancer and carcinogenesis are the major challenges facing global medicinal chemistry [1], mainly in the part of preventative toxicology [2,3] as it assumes an idealized toxicity against organisms and acts through a subtle, undiscovered molecular mechanism. The basic mechanism in cancer cell proliferation is through a variety of compounds, making it difficult to assess specific ligand-receptor interaction patterns [4,5].

Pesticides are agents designed to kill insects, weeds, fungi, rodents, and other unwanted animals and plant life. Many are carcinogenic in animal bioassays and some are known or suspected to be human carcinogens [6]. The International Agency for Research on Cancer (IARC) had classified 26 pesticides as having sufficient evidence of carcinogenicity in animals and 19 as having limited evidence in animals [7,8].

The epidemiological evidence on the association between tobacco smoking and cancer was well established. Studies published since the 1986 IARC Monograph on “Tobacco smoking” provide sufficient evidence to establish a causal association between cigarette smoking and cancer of the nasal cavities and paranasal sinuses, nasopharynx, stomach, liver, kidney (renal cell carcinoma) and uterine cervix, and for adenocarcinoma of the oesophagus and myeloid leukaemia. These sites add to the previously established list of cancers causally associated with cigarette smoking, namely cancer of the lung, oral cavity, pharynx, larynx, oesophagus, pancreas, urinary bladder and renal pelvis. It has been estimated that every other smoker will be killed by tobacco [9].

In the Sudan, snuff, locally known as Toombak, plays a significant role in etiology of oral squamous cell carcinomas (OSCCs), with the tobacco specific nitrosamines present in Toombak possibly acting as principal carcinogens. Toombak dippers develop a clinically and histologically characteristic lesion at the site of dipping [10].

Alcohol consumption has been associated with a variety of different forms of cancer in man for several centuries. The evidence linking alcohol drinking to cancer risk has been reported in several studies [11,12,13]. There is convincing epidemiological evidence that the consumption of alcoholic beverages increases the risk of cancers of the oral cavity, the pharynx and the larynx, and the risk of squamous cell carcinoma of the oesophagus [14].

Bisphenol A (BPA) is largely used in the manufacture of polycarbonate plastics and is the constituent of a wide array of consumer products, including plastic food containers, baby bottles, and the lining of metal food cans [15]. Humans are exposed to BPA mainly at the time of consumption of water and foods through the materials used for containers and packages [16]. Exposure to BPA has been correlated with the incidence of diverse types of tumors, particularly breast cancer [17,18,19].

As much as 40% of all cancer deaths can be prevented by avoiding known risk factors causing cancer [20]. There is sufficient literature which suggests that measures like risk identification, prevention and early detection can help us achieve substantial control over the rapidly increasing burden of cancer. The goal of cancer awareness campaigns is to raise the public's "brand awareness" for cancer causes, cancer early detection, and other reliable, prevention measures. Therefore, the objective of this study was to assess the burden of exposure, knowledge and attitude toward some common chemical carcinogens in Northern State of Sudan.

MATERIALS AND METHODS

This is a community-based, cross-sectional study was conducted in North State of Sudan, during the period from March to April 2010. Data was collected as a part of cancer awareness campaign that covered an
area inhibited with 40,000 individuals. People were gathered in certain centers (Schools, Clubs Health centres), then were asked to fill the questionnaire about occupational exposure to some chemicals (including: Tobacco use, Alcohol consumption, Insecticides exposure, Plasticizers exposure, Radiation exposure, Chemical usage and preserved food), and other information regarding their attitudes towards these factors.

STATISTICAL ANALYSIS
Statistical analysis was performed by proportion. The Microsoft Excel Office 2007 and the SPSS software (version 16) were used for statistical analysis.

ETHICAL CONSENT
Written informed consent was obtained from each respondent, ensuring strict anonymity. The Ethical Committee of the Department of Histopathology and Cytology, FMLS, University of Khartoum has approved the study.

RESULTS
Of the 187 (96.4%), who responded to the question, whether they have a continuous contact with insecticides, 118/187 (63.1%) answered yes. Also 62/191 (30%) have declared that they use to eat fresh vegetable in the farm without washing. Of the 191 respondents regarding tobacco and alcohol habits, 59 (31%), 76 (40%) and 28 (15%), of tobacco smokers, toombak dippers and alcoholic beverage users respectively, have used or currently using these products (table 1). On asking the participants whether they have relatives with cancer, 55/187 (26.6%) have stated that they have relatives with cancers. Of the 55 subjects having relatives with cancer, 74.5% have only one relative with cancer, 11% have two relative with cancers, 3.6% have four relatives and 1.8% has six relatives with cancers. The most declared cancers were stomach 18.2%, Leukemia 11%, Breast 9%, Oral 9%, Prostate 7.2%, Lung 5.4%, Cervix 3.6% and others 14.5%, as indicated in figure1.

On asking the study subjects, about whether chemical carcinogens can cause cancer, (1.9% and 33.8%), (1.4% and 17.9%), (3.4% and 32.4%), (9.2% and 25%), 5.8% and 23.7%), 3.4% and 32.9%), (0% and 38.2%) and 16.9% and 31.4%) of Tobacco smoking, Toombak dipping, Alcohol consumption, Insecticides exposure, Plasticizers exposure, Radiation exposure, Chemical usage and preserved food, respectively, answered (No and Don’t know), per capita, as shown in Table2, Figure 2.

DISCUSSION
Measuring cancer awareness is important; as it gives the policy makers and health care givers an opportunity to understand the impact of the interventions and do what is possible to get the desired outcomes. Promotion of cancer awareness has potential impacts on cancer control. Knowledge of potential carcinogenic may assist in reducing or prevention of exposure. However, this study evaluated

<table>
<thead>
<tr>
<th>Variable</th>
<th>Yes (%)</th>
<th>No (%)</th>
<th>Don’t know</th>
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<tbody>
<tr>
<td>Tobacco smoking</td>
<td>133 (64.3%)</td>
<td>4 (1.9%)</td>
<td>70 (33.8%)</td>
</tr>
<tr>
<td>Toombak dipping</td>
<td>167 (80.7%)</td>
<td>3 (1.4%)</td>
<td>37 (17.9%)</td>
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<tr>
<td>Alcohol use</td>
<td>133 (64.3%)</td>
<td>7 (3.4%)</td>
<td>67 (32.4%)</td>
</tr>
<tr>
<td>Insecticides</td>
<td>135 (65.2%)</td>
<td>19 (9.2%)</td>
<td>53 (25%)</td>
</tr>
<tr>
<td>Plasticizers</td>
<td>146 (70.5%)</td>
<td>12 (5.8%)</td>
<td>49 (23.7%)</td>
</tr>
<tr>
<td>Radiation</td>
<td>132 (63.8%)</td>
<td>7 (3.4%)</td>
<td>68 (32.9%)</td>
</tr>
<tr>
<td>Chemical usage</td>
<td>128 (61.6%)</td>
<td>0</td>
<td>79 (38.2%)</td>
</tr>
<tr>
<td>Preserved food</td>
<td>107 (51.7%)</td>
<td>35 (16.9%)</td>
<td>65 (31.4%)</td>
</tr>
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</table>

Figure 1. Description of relative having cancers with different cancers

Table 1. Distribution of the study population by Exposure

<table>
<thead>
<tr>
<th>Variable</th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
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<tbody>
<tr>
<td>Pesticides exposure</td>
<td>118 (63.1%)</td>
<td>69 (33.3%)</td>
</tr>
<tr>
<td>No vegetable washing</td>
<td>62 (30%)</td>
<td>129 (62.3%)</td>
</tr>
<tr>
<td>Tobacco smoking</td>
<td>59 (31%)</td>
<td>132 (69%)</td>
</tr>
<tr>
<td>Toombak dipping</td>
<td>76 (40%)</td>
<td>115 (60%)</td>
</tr>
<tr>
<td>Alcohol consumption</td>
<td>28 (15%)</td>
<td>163 (85%)</td>
</tr>
</tbody>
</table>
exposure, knowledge and attitude towards certain chemicals that are widely used in the Northern State of Sudan.

Pesticides are widely used in agricultural and other settings, resulting in continuing human exposure. Epidemiologic studies indicate that, in progress exposures are associated with risks to human health [21]. In this there is a very high pesticides direct exposure (63.1%). Also many people use to eat vegetables and other agricultural products without washing (30%) which in most instances containing pesticides and other chemical additives. On asking these people, whether these pesticides have a link with cancer, 9.2% answered no and 25% answered don't know. Epidemiologic evidence on the relationship between chemical pesticides and cancer is established. In animal studies, many pesticides are carcinogenic, (e.g., organochlorines, creosote, and sulfallate) while others (notably, the organochlorines DDT, chlordane, and lindane) are tumor promoters. In humans, arsenic compounds and insecticides used occupationally have been classified as carcinogens by the IARC on Cancer. Human data, however, are limited by the small number of studies that evaluate individual pesticides. Epidemiologic studies, although sometimes contradictory, have linked phenoxy acid herbicides or contaminants in them with soft tissue sarcoma (STS) and malignant lymphoma; organochlorine insecticides are linked with STS, non-Hodgkin's lymphoma (NHL), leukemia, and, less consistently, with cancers of the lung and breast; organophosphorous compounds are linked with NHL and leukemia; and triazine herbicides with ovarian cancer [22].

The proportions of tobacco and alcohol users are relatively higher in the studied sample. The great majority were toombak users constituting 40% followed by smokers 31% and alcoholic 15%. On measuring their attitude and knowledge about these chemicals, many people ignore the risk of these products. However, 35.7%, 19.3% and 35.8% of smokers, toombak dippers and alcoholic beverage users ignore the relationship between cancer and these products. Currently, tobacco smoking causes approximately 5-6 million deaths per year including more than 35% of all cancer deaths. Nicotine, the addictive constituent of tobacco, and its derived carcinogenic nitrosamines, contribute to cancer promotion and progression through the activation of nicotinic acetylcholine receptors (nAChR). Nicotine induces DNA damages, via induction of oxidative stress, in bronchial epithelial cells [23]. Although, the knowledge of people about the risk of toombak and cancer is relatively higher, but many people still using it. Many studies have showed the potential risk of toombak in etiology of oral cancer [24,10,25]. The present data points to the urgent need for educational programs and preventive measures against the use of toombak.

Plasticizers are commonly used in Sudan, and mostly as food containers. Plastic containers are frequently used for handling hot and cold food and drinks, such as, boiled milk or some common tradition food (Fool), as well as used for storing frozen food. In this study, 29.5% of the study subjects ignore the health effects of these materials. Butyl benzyl phthalate (BBP) is a plasticizer commonly used in pipes, vinyl floor tiles, vinyl foams, and carpet backing, and to a minor extent, in cellulose plastics and polyurethane 9. This compound has shown to be weakly estrogenic [26] and to induce adverse effects on the development of male reproductive system; thus acting as an endocrine disruptor. BBP has shown endocrine-disrupting properties, thus having a potential effect on hormone sensitive tissues [27]. However, some studies have reported the link between exposure to Plasticizers and risk of cancer particularly, breast and testicular cancers (28,29,27).

The association between cancer and exposure to ionizing radiation has been well documented [30]. Evidence for this association is derived mainly from data on atomic bomb survivors and from patients who, a few decades ago, received high doses of therapeutic radiation for diseases other than cancer. Associations between ionizing radiation and specific types of cancer, particularly leukemia, have also been well established [31]. In this study, 63.8% of the participants have claimed their regular exposure to minor sources of radiation exposure, either diagnostic or therapeutic of occupational.

Conclusion: The data at hand point to the urgent need for educational programs and preventive measures against the exposure to carcinogenic chemicals. The need for in-depth epidemiological studies and further specific

![Figure 2. Description of study population by knowledge of chemical carcinogens](image-url)
measurements to prove that exposure to these risk factors have impact on cancer burden in Northern Sudan is urgently needed.

References

5. KNUDSON, A.G.-Two genetic hits (more or less) to cancer. Nat Rev Cancer, 1:157-162; 2001;
6. HOAR ZAHM, Shelia and WARD Mary H.-Pesticides and Childhood Cancer. Environ Health Perspect; 106(3):893-908; 1998;
15. WELSHONS, W.V., NAGEL, S.C., vom SAAL, F.S.-Large effects from small exposures. III. Endocrine mechanisms mediating effects of bisphenol A at levels of human exposure. Endocrinology;147:S56-S69; 2006;