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Editorial Board

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PREFACE

Dear readers of the Journal of Middle East and North Africa Sciences,

It is a great pleasure to publish this issue of the Journal of Middle East and North Africa Sciences for our readers. The issue is composed of 3 different papers having an acceptance rate of 82% in various disciplines of science. We would like to thank all authors, referees, our editorial board members and content editors that show efforts for the publication of the issue.

I would like to invite you to submit your manuscripts to the next issue of the Journal of Middle East and North Africa Sciences.

Ahmad Saleh, PhD
Editor-in-Chief

How to Minimize Groin Bulging after Herniorrhaphy?

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Editorial:

Up to date, all of us have to face a common challenge that the discomfort of bulging in patients after groin hernia repair happened frequently despite there are no any specific findings from ultrasound examination in its early stage. In fact, the majority of people prefer to choose a high-quality Herniorrhaphy rather than a low-cost mesh (Löfgren et al., 2016).

Herein, Authors would like to introduce a novel groin hernia repair named as “Hernia Sac Top (HST) pathway”. The method can tie hernia sac, mesh, and loophole-closing into an entire unit with suture (Zhong et al., 2015; Wang et al., 2016), and promise a high-degree supportive power exist in the groin area. The unique technique appears to be very interesting but really does matter to reduce the discomfort of bulging after surgery. Authors get the truth and learn more from our practical experiences. Obviously, HST could maintain the integrity of groin area as the most extent as possible.

Authors just walk on Bassini's footprint, who emphasizes to close the hole exist in transversalis fascia with purse string suture and high ligation. HST pins the hole and hernia sac on the mesh simultaneously. All joint dedication to reconstruct a stronger and firm groin area will make a hernia go further as time marches on.

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Keywords: Bulging; Groin hernia repair; Hernia sac top

5. Declaration:
All authors declare they have no any conflicts of interests concerning on the letter.

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Equilibrium, Kinetic and Thermodynamic Assessment of the Adsorption of Cadmium Using Water Lily (Nymphaea Ampla) Leaf Biomass

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Abstract: The adsorption of cadmium (II) ions from aqueous solution by Nymphaea ampla leaf biomass was carried out with effects of initial cadmium concentration, solution pH, contact time, adsorbent dose and temperature of the process investigated. An adsorbent dosage of 120 mg showed maximum metal uptake capacity (q_e) of 2.75 mg/g (82.6%) for an initial metal ion concentration of 2.0 mg/L and pH 7. Sorption equilibrium time was observed in 30 minutes. The equilibrium adsorption data were analyzed by the Langmuir, Freundlich, Temkin and Dubinin-Radushkevich (D-R) adsorption isotherm models. Freundlich isotherm yielded the best fit to the experimental equilibrium adsorption data with a correlation coefficient (R^2) of 0.990. The kinetics of cadmium (II) ions adsorption was discussed using pseudo-first-order, pseudo-second-order, and intraparticle diffusion models. It was discovered that the adsorption of cadmium (II) ions could be described by the pseudo-second-order kinetic model. Thermodynamic parameters such as Gibbs free energy (ΔG^0), enthalpy (ΔH^0) and entropy change of the sorption (ΔS^0) evaluated showed that the process was spontaneous, feasible and exothermic in nature. The results indicated that Nymphaea ampla leaf biomass can be used as an effective and low-cost adsorbent to remove cadmium (II) ions from aqueous solutions.

To cite this article
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Keywords: Adsorption, Biomass, Cadmium (II) ion, Equilibrium, Kinetics, Thermodynamics

1. Introduction:

Heavy metals are present in the environment through natural and artificial sources. Industrialization has led to the generation of large quantities of liquid effluents, most of which contain heavy metals such as cadmium, lead, nickel, mercury, arsenic, chromium, zinc… etc. (Andres et al., 1992; Varma et al., 2010). Heavy metals are threats to both flora and fauna due to their bioaccumulation tendency and toxicity in biological systems (Friis and Myers - Keith, 1986; Singh et al., 2012). Cadmium is one of the heavy metals whose toxicity contributes to a large number of health conditions, including the major killer diseases such as heart disease, cancer, and diabetes (Hussein & Mohey, 2011). Cadmium concentrates in the kidney, liver, and other organs and is considered more toxic than both lead and mercury. The removal of these metals from both municipal and industrial wastes/effluents before being discharged into the ambient environment. Therefore, paramount in order to reduce the negative effects (Asiagwu, 2012).

Conventional treatment methods such as ion - exchange, reverse – osmosis, precipitation, flocculation, electro thermal treatment, solvent extraction… etc. have disadvantages like incomplete metal removal, high reagent and energy requirements, high cost and generation of toxic sludge's to mention but few. The search for suitable environmental – friendly alternative techniques that are affordable, efficient and can complement or replace the existing methods has been in place for some time now and attention is been directed to biosorption based on metal binding capacities of various biological materials (Tien, 2002; Hanif et al., 2007; Tuzen et al., 2008). In this study, the potential of Nymphaea ampla leaf to adsorb cadmium from aqueous solutions is being studied.

2. Materials and Methods:

2.1. Preparation of Biosorbent:

Matured Nymphaea ampla leaves were harvested from a farm behind the Abuja Hostel of the University of Jos, Plateau State, Nigeria. The leaves were thoroughly washed with deionized water and air-dried. The dried leaves were then grinded and sieved

with a 250µm mesh and stored in an air-tight container.

2.2. Batch Adsorption Experiments:

All glassware's were washed with 1M HNO_3 and subsequently rinsed severally with deionized water to remove all possible interferences. Batch adsorption studies were carried out in 250 mL Erlenmeyer flasks to study the influence of initial cadmium ion concentration (0.5 mg/L to 5.0 mg/L), pH (4.5 to 7.0), contact time (5 to 120 min), adsorbent dose (10 mg to 120 mg) and temperature (150^0C to 55^0C). The experimental flasks were agitated at 200rpm in a rotating shaker for a specified time period. The pH of the solution was adjusted with 0.1M NaOH and HNO_3 as the case may be. At the end of the experiments, the flasks were removed from the shaker and the solutions separated from the biomass by filtration using filter paper (Whatman no.1) and the filtrate analyzed for residual cadmium (II) ion concentration using atomic adsorption spectrophotometer (AAS), model DK420. The metal uptake capacity (q_e) and the adsorption efficiency (E) were calculated using the following equations:

$$q_e = \frac{(C_i - C_e)V}{M} \qquad (1)$$

$$E = \left[\frac{C_i - C_f}{C_i}\right] x100 \qquad (2)$$

where C_i = Initial cadmium concentration in mg/L, C_f = Final cadmium concentration in mg/L, V = Volume of the reaction mixture (L) and M = mass of the adsorbent in the reaction mixture (g).

3. Results and Discussion:

3.1. Effect of initial Cadmium (II) ion concentration:

The rate of adsorption is a function of the initial concentration of the adsorbate which makes it an important factor to be considered for effective adsorption. As shown in Figure 1, the adsorption capacity at equilibrium increased with increase in initial cadmium (II) ion concentration. This is considered possible due to the fact that the initial concentration of the metal ions provided the necessary driving force to overcome the mass transfer resistance of the cadmium (II) ions in the aqueous phase (Chowdhury and Saha, 2010). The increase in initial concentration also enhances the interaction between the cadmium ions in the aqueous phase and the biomass. Similar results were obtained in the adsorption of chromium (VI) ions onto natural plant materials by Devaprasath et al. (2007).

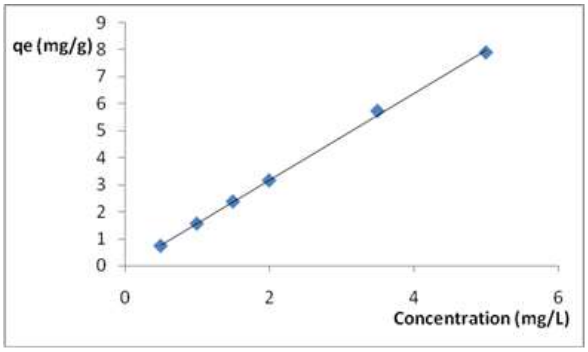

Figure 1. Effect of initial concentration (adsorbent dose = 30 mg, time = 45 mins).

3.2. Effect of pH

The effect of pH on the removal efficiency of cadmium (II) ion by Nymphaea ampla leaf biomass is shown in Figure 2 for a pH range of 4.5 to 7.0. Maximum adsorption was obtained at pH 7.0 which was subsequently used for other batch studies. The results showed that acidic conditions did not favour sorption of cadmium (II) ions onto Nymphaea ampla leaf. The reason could be that, under acidic conditions, the surface of the adsorbent may be closely associated with H^+ and $H3O^+$ which may hinder the access of metal ions to the surface of the adsorbent thereby reducing the percentage metal ion adsorption (Sar and D'Souza, 2002).

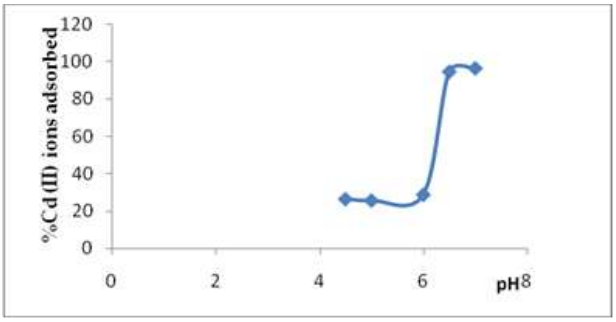

Figure 2. Effect of pH (adsorbent dose = 30 mg, initial concentration = 2.0 mg/L).

3.3. Effect of Contact Time

The uptake of cadmium (II) ion as a function of contact time is shown in Figure 3. Adsorption of cadmium (II) ion increased with the rise in contact time up to 30 minutes. Further increase in contact time resulted in decreased adsorption. At 30min., 80.8% adsorption was achieved. The fast adsorption rate at the initial stage may be as a result of more availability of active adsorbing / binding sites in the adsorbent surface (DAS et al., 2012). The decrease in adsorption observed as time progresses beyond 30min. may be due to the fact that every adsorbent has limited a number of active sites which becomes occupied with

time and continuous agitation may result in desorption (Badmus et al., 2007). Similar results were obtained by Dawodu et al., (2012) who observed maximum adsorption of cadmium (II) ion onto Agbani clay from aqueous solutions at 50 min.

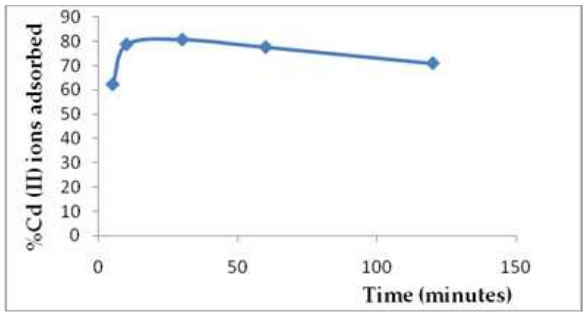

Figure 3. Effect of contact time (pH = 7.0, concentration = 2.0 mg/L, dose = 30 mg).

3.4. Effect of Biomass Dose

The adsorbent dose is a significant factor for sorbent – sorbate equilibrium of a system (Saleem and Bhatti, 2011). From Figure 4, the percent removal increased with increase in adsorbent dose. This was possible due to increased surface area of the adsorbent which in turn increased the number of active binding sites. Maximum cadmium uptake (83%) was observed with the 120 mg dose. Similar results were reported by Varma et al. (2010) for cadmium (II) ion adsorption using *Psidium guajava* leaves powder.

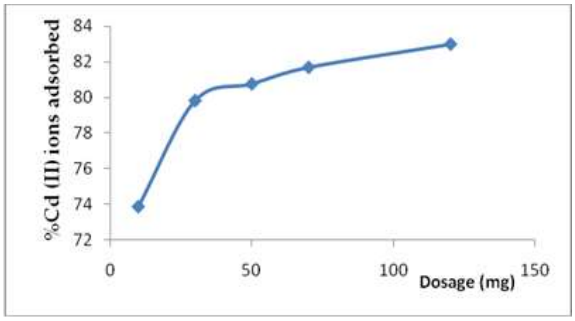

Figure 4. Effect of adsorbent dose (pH = 7.0, concentration = 2.0 mg/L, time = 30 min).

3.5. Effect of Temperature

The temperature effect is shown in Figure 5. From the results, the adsorption of cadmium (II) ion decreased with increasing temperature. This is probably due to the exothermic behaviour between the surface of the biomass and cadmium ions which resulted from the weakening of attractive forces between them and decreases in the thickness of the boundary layer (Cruz et al., 2004; Horsfall and Spiff, 2005; Bhatti et al., 2009). Similar results were obtained for the adsorption of cadmium (II) using Nymphaea ampla root biomass (Gongden et al., 2014).

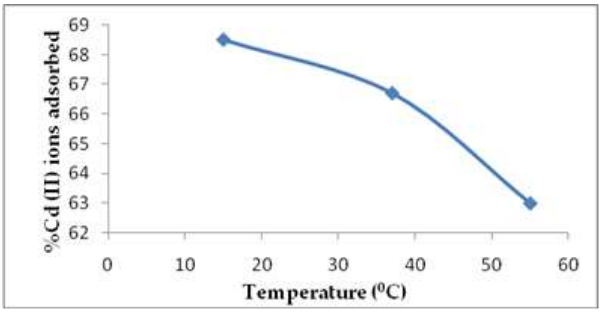

Figure 5. Effect of temperature (pH = 7, concentration = 2.0 mg/L, time = 30 min, dose = 120 mg).

3.6. adsorption Isotherm Models

The extent of adsorption was estimated using the Langmuir, Freundlich, Temkin and Dubinin-Radushkevich (D-R) adsorption isotherms. Adsorption isotherm is the basic requirement for designing any adsorption system. Isotherm expresses the relation between the amounts of adsorbate removed from the liquid phase by a unit mass of adsorbent at constant temperature (Shokoohi et al., 2009). The obtained experimental data here are expectedly well fitted with the Linearized form of these four two-parameter isotherm models.

Langmuir Isotherm:

$$q_e = \frac{q_{max} K_L C_e}{1 + K_L C_e} \quad (3)$$

Linearised Langmuir Isotherm:

$$\frac{1}{q_e} = \frac{1}{q_e K_L C_e} + \frac{1}{q_{max}} \quad (4)$$

where q_{max} is the maximum adsorption capacity (mg/g) and K_L is the Langmuir equilibrium constant (L/mg) related to the energy of adsorption which quantitatively reflects the affinity between the adsorbent and adsorbate. To further quantify the adsorption properties of the Langmuir isotherm, a dimensionless separation factor, R_L was used. This is given as:

$$R_L = \frac{1}{1 + K_L C_i} \quad (5)$$

The value of RL indicates the type of Langmuir isotherm to be irreversible (R_L=0), favorable (0< R_L <1), linear (R_L =1) or unfavorable

(R_L >1). Apparently when K_L>0, sorption is favorable (Langmuir, 1918; Ho et al., 2002).

The Freundlich isotherm, applicable to non-ideal heterogeneous surfaces was chosen to estimate the adsorption intensity of the adsorbent and the linear form of the isotherm can be represented as:

$$\ln q_e = \ln K_F + 1/n \ln C_e \quad (6)$$

Where K_F and n are Freundlich constants which correlated to the maximum adsorption capacity and adsorption intensity respectively (Freundlich, 1906).

Temkin isotherm takes into account the interactions between adsorbents and metal ions to be adsorbed and is based on the assumption that the free energy of sorption is a function of the surface coverage (Liu and Liu, 2008).

Temkin isotherm: $q_e = RT/b_T \ln(AC_e)$ (7)

Linearised Temkin isotherm: $q_e = B\ln A + B\ln C_e$
where $RT/b_T = B$ (8)

where T is the temperature (^{0}K), R is the ideal gas constant (8.314Jmol^{-1}K^{-1}), A and B are constants. The constant bT is related to the heat of adsorption and A is the equilibrium binding constant (L/g) corresponding to the maximum binding energy (Pearce et al., 2003; Akkyar and Özer, 2005).

The Dubinin-Radushkevich (D-R) model was chosen to estimate the heterogeneity of the surface energies. The linear form of D-R isotherm equation is represented as:

$\ln q_e = \ln q_m - \beta\varepsilon^2$; where $\varepsilon = RT\ln(1+1/C_e)$ (9)

where q_m is the theoretical saturation capacity (mg/g), β is a constant related to the mean free energy of adsorption per mole of the adsorbate (mol^2/J^2) and ε is the Polanyi potential, R (Jmol^{-1}K^{-1}) is the gas constant and T(^{0}K) is the absolute temperature. The constant β gives an idea about the mean free energy E (J/mol) of adsorption per molecule of the adsorbate when it is transferred to the surface of the solid from infinity in the solution and can be calculated from the relationship (Erdem et al., 2004; Kundu, and Gupta 2006):

$$E = \frac{1}{\sqrt{2\beta}} \quad (10)$$

The isotherm plots for the sorption of the metal ions are shown in Figures 6 to 9 and the results are as shown in Table 1. Freundlich adsorption isotherm model yielded best fit to the experimental equilibrium adsorption data than the Langmuir, Temkin, and D-R isotherm models for cadmium (II) adsorption according to the values of R^2 obtained. It was also seen that the Langmuir maximum adsorption capacity (q_{max}) is 3 mg/g and the equilibrium constant (K_L) is 13 L/mg. From the values of R_L (Table 2), it could be seen that the isotherm was favorable for the adsorption of cadmium (II) ion onto the biomass.

According to Abasi et al. (2011), n values between 1 and 10 shows easy separation beneficial adsorption and high affinity of the adsorbent to the metal ions. For D-R isotherm, it has been reported that physisorption processes usually have adsorption energies < 40 KJ/mol and above this value, sorption is of chemisorption mechanism (Horsfall et al., 2004). If the mean biosorption energy (E) value is between 8.0 and 16.0 KJ/mol, the biosorption process follows chemical ion exchange and if E < 8.0 KJ/mol, the biosorption process is of a physical nature (Lodeiro et al., 2006; Sarı et al., 2007). Therefore, E value of 3.54 KJ/mol showed that the sorption process was of a physical nature for the adsorption of cadmium (II) ion onto Nymphaea ampla leaf biomass.

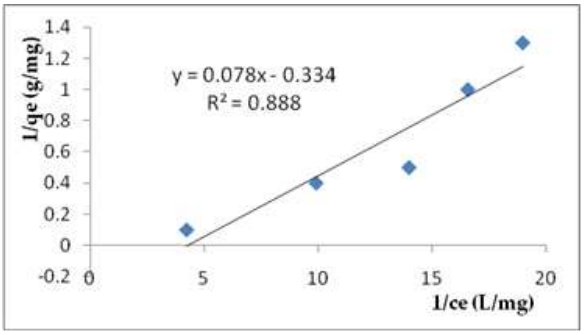

Figure 6. Langmuir isotherm model for cadmium adsorption.

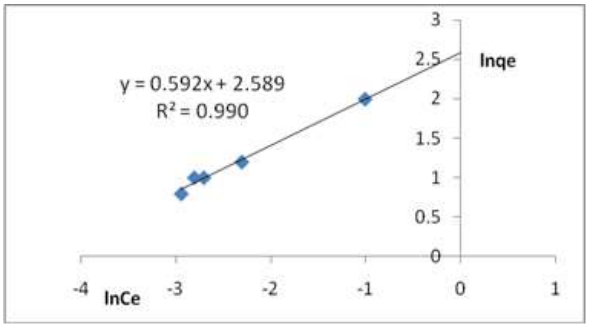

Figure 7. Freundlich isotherm model for cadmium adsorption.

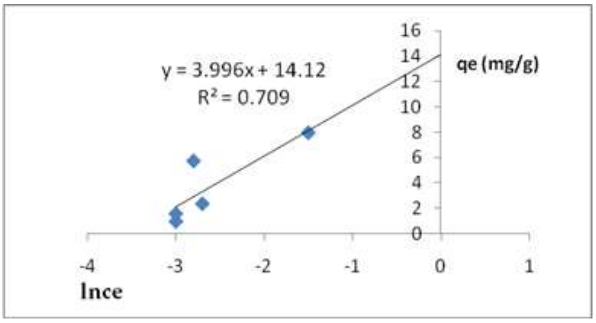

Figure 8. Temkin isotherm model for cadmium (II) adsorption.

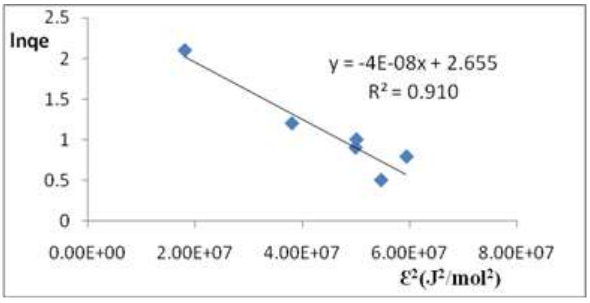

Figure 9. D-R isotherm model for cadmium (II) adsorption.

Table 1: *Summary of Adsorption Isotherm Constants for Cadmium (II) ions Sorption onto Nymphaea ampla Leaf Biomass*

Langmuir Isotherm	Freundlich Isotherm	Temkin Isotherm	D-R Isotherm
q_{max} = 3.0mg/g	K_F = 13.3 mg/g	A_T = 34.24 L/mg	q_m = 2.66 mg/g
K_L = 13.0L/mg	1/n = 0.592	B = 3.99 mg/g	$\beta = 4 \times 10^{-5} mol^2/KJ^2$
R^2 = 0.888	n = 1.7	b_T = 0.65 KJ/mol	E = 3.54 KJ/mol
	R^2 = 0.990	R^2 = 0.709	R^2 = 0.910

Table 2: *Dimensionless Langmuir Separation Factor*

Concentration (mg/L)	0.5	1.0	1.5	2.0	3.5	5.0
R_L	0.1333	0.0714	0.0488	0.0370	0.0215	0.0152

3.7. Adsorption Kinetic Modeling

In order to analyze the rate of adsorption and possible adsorption mechanism of Cd (II) onto the biomass, the Lagergren first-order, pseudo-second order and intra-particle diffusion kinetic models were applied to adsorption data.

The Lagergren first-order rate equation is represented as (Lagergren, 1891):

$$Log\ (q_e - q_t) = Log q_e - \frac{K_1 t}{2.303} \quad (11)$$

The pseudo-second order equation is given as (Saleem and Bhatti, 2011):

$$\frac{t}{q_t} = \frac{1}{k_2 q_e^2} + \frac{t}{q_e} \quad (12)$$

where q_e is the mass of metal adsorbed at equilibrium (mg/g), q_t the mass of metal adsorbed at time t (min), k_1 is the pseudo- first order rate constant of adsorption (min^{-1}) and k_2 the pseudo-second order rate constant of adsorption (mg/g.min).

The kinetic results were analyzed by the Weber and Morris intraparticle diffusion model to elucidate the diffusion mechanism. The model is expressed as (Weber and Morris, 1963):

$$q_t = kd\ t^{1/2} + I \quad (13)$$

where I is the intercept which describes the boundary layer thickness and kd ($mg/g.min^{1/2}$) is the rate constant of intraparticle diffusion. A line passing through the origin indicates that intra-particle diffusion is the sole rate-limiting step (DAS et al., 2012). Table 3 shows the results for the application of different kinetic models to cadmium biosorption by Nymphaea ampla leaf biomass.

Cadmium adsorption onto the biomass follows the pseudo-second order model which indicates that the adsorption of cadmium is proportional to the square of the vacant sites of the biomass. The value of q_e obtained from the pseudo-second order model is in close agreement with that of the experimental value, while the value obtained from the pseudo-first order is quite small. Application of Weber-Morris equation to kinetic data revealed that cadmium adsorption did not follow the equation as shown by the low value of the correlation coefficient.

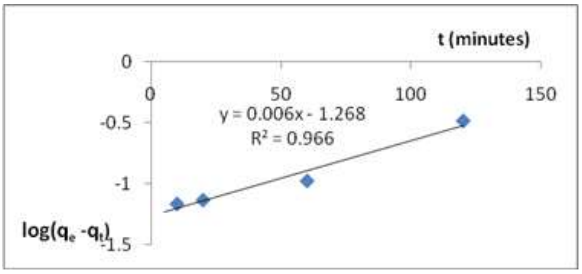

Figure 10. First order kinetics for cadmium (II) adsorption

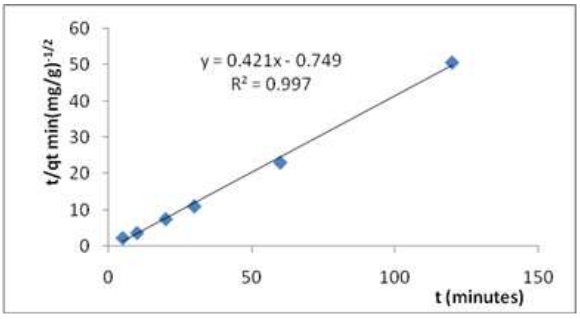

Figure 11. Second order kinetics for cadmium (II) adsorption.

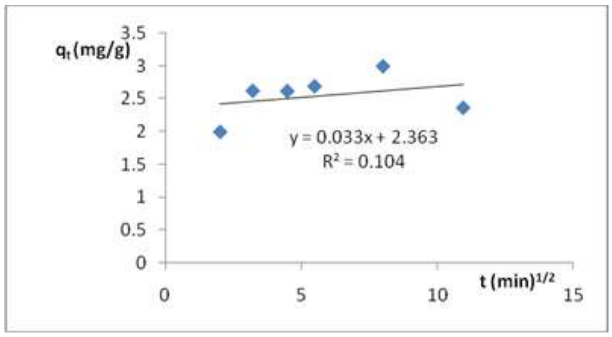

Figure 12. Intra-particle diffusion model for cadmium (II) adsorption.

Table 3: *Comparison between kinetic models for Cadmium (II) ions sorption unto Nymphaea ampla leaf biomass.*

Pseudo-first order	Pseudo-second order	Intra-particle diffusion
q_e, exp = 2.694mg/g	K_2 = 0.213g/mg.min	K_d = 0.033mg/g.min$^{1/2}$
q_e, cal = 0.05mg/g	q_e, cal = 2.5mg/g	I = 2.363
K_1 = 1.38x10^{-2}min^{-1}	R^2 = 0.997	R^2 = 0.104
R^2 = 0.966		

3.8. Thermodynamic Treatment of the Sorption Process

The thermodynamic parameters such as free energy change (ΔG^0), enthalpy change (ΔH^0) and entropy change (ΔS^0) were evaluated using the following expressions:

$$\Delta G = -RT\ln k_c \quad (14)$$

$$K_c = \frac{C_{Ae}}{C_e} \quad (15)$$

$$\log K_c = \frac{\Delta S^0}{2.303R} - \frac{\Delta H}{2.303RT} \quad (16)$$

where C_e is the equilibrium concentration in solution in mg/L, C_{Ae} is the equilibrium concentration on the sorbent in mg/L and KC is the thermodynamic equilibrium constant.

T is the absolute temperature in Kelvin and R is the universal gas constant (8.314 JK^{-1}mol^{-1}). The Gibbs free energy (ΔG^0) for the adsorption of cadmium (II) onto biomass at all temperatures was obtained from Eq. 14 and is presented in Table 4.

The values of ΔH^0 and ΔS^0 were calculated from the slope and intercept of the plot logKc against 1/T (Figure 13) and are also listed in Table 5. In order to support that physical adsorption is the predominant mechanism, the values of activation energy (Ea) and sticking probability (S*) were calculated from the experimental data. They were calculated using modified Arrhenius type equation related to surface coverage (θ) as follows (Horsfall and spiff, 2005):

$$\theta = \left(1 - \frac{C_e}{C_i}\right) \text{ and } S^* = (1-\theta)exp - \frac{E_a}{RT} \quad (17)$$

The guidelines for the potential sticking probability are; $S^*>1$ indicates no sorption, $S^*=1$ indicates linear sticking relationship between adsorbent and adsorbate and mixture of physisorption and chemisorption, $S^*=0$ indicates indefinite sticking of adsorbate to adsorbent with chemisorption being the predominant mechanism and $0 < S^* < 1$ indicates favorable sticking of the adsorbate with physisorption being the predominant mechanism.

From Table 4 it is clear that the reaction is spontaneous in nature as ΔG^0 values are negative at all the temperatures studied. Again negative ΔH^0 value confirms that the sorption is exothermic in nature. The negative value of ΔS^0 reflects decreased randomness at the solid-solution interface during the adsorption of cadmium (II) ions. The value of Ea was found to be -1.88 kJ/mol for the adsorption of cadmium (II) onto biomass. The negative value of Ea indicates the exothermic nature of the adsorption process which is in accordance with the negative value of ΔH^0. The result as shown in Table 5 indicate that the probability of the cadmium (II) ions to stick on the surface of biomass is high as $S^*< 1$, these values confirm that the sorption process is physisorption.

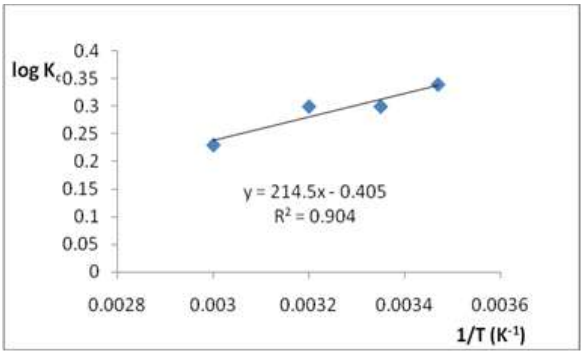

Figure 13. The plot of logK_C against 1/T for Cd (II) ion adsorption.

Table 4: *Values for Gibb's Free Energy at Various Temperatures.*

T (^{0}K)	288	298	310	318	328
ΔG^0(KJ/mol)	-1.860	-1.860	-1.798	-0.482	-1.447

Table 5: *Thermodynamic Parameters for adsorption of Cd (II) ions onto Nymphaea ampla Biomass.*

ΔS0(KJ/mol)	ΔH0(KJ/mol)	Ea(KJ/mol)	S*
-0.0078	-4.10	-1.88	0.752

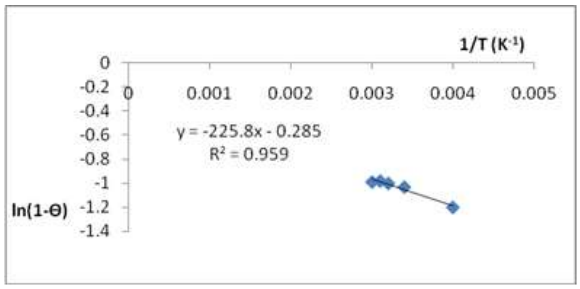

Figure 14. The relationship between temperature and sticking probability for Cd (II) adsorption.

4. Conclusion

The biomass of Nymphaea ampla leaf proves to be highly efficient adsorbent for the removal of cadmium (II) ions from aqueous solution. The adsorption process is also dependent on numerous factors such as initial metal ion concentration, the solution pH, contact time, adsorbent dosage and temperature. The maximum adsorption of cadmium (II) ions was found to be at pH 7 for a 3.2 mg/g biomass and initial cadmium concentration of 2.0 mg/L. The study on equilibrium sorption revealed that Freundlich isotherm model gave the best fit to experimental data. In the study of the kinetics of sorption, the pseudo-second-order kinetic model provides better correlation of the sorption data. Intra-particle diffusion was not the sole rate-limiting step. The calculated thermodynamic parameters showed the exothermic and spontaneous nature of the adsorption of cadmium onto Nymphaea ampla leaf biomass. Furthermore, calculated sticking probability indicates excellent sticking of metal ions onto Nymphaea ampla leaf biomass. The present findings suggest that Nymphaea ampla leaf biomass may be used as an inexpensive and effective adsorbent for the removal of cadmium (II) ions from aqueous solution.

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Colorectal Cancer: Exploring Awareness in Lebanon

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ABSTRACT

Background: In 2014, the World Health Organization (WHO) has identified Colorectal Cancer (CRC) as the fourth leading cause of cancer-related deaths (694,000 deaths) after lung (1.59 million deaths), liver (745,000 deaths) and stomach (723,000 deaths) cancers. Thus, CRC awareness is needed in order to promote CRC screening which is widely recommended but remains underused, especially among poor populations.

Objective: The study assessed the current understanding of CRC among the Lebanese population in order to propose recommendations that may contribute to increasing the screening rates where it is widely known that the survival rate increases significantly with early interventions.

Materials and Methods: The study surveyed 1140 participants that were approached in public places, universities, entrances of the hospitals or places of work as well as following a snowball tactic by giving some potential participants few surveys to complete within their own social circles. The survey included questions related to risk factors, symptoms, and methods of screening. Quantitative data was analyzed using SPSS version 23.0 software.

Results: The results of this study underline the lack of knowledge on CRC where the percentage of respondents that has never heard about it exceeds 59%; likewise, the study underlines the lack of knowledge on CRC screening where the percentage of respondents that have heard about it while claiming that they are familiar with CRC does not exceed 57.17%. Similarly, the results revealed poor knowledge in what relates to CRC risk factors and symptoms.

Conclusions: Lack of awareness on CRC and its common risks and symptoms terminology is a barrier to CRC screening; accordingly, effective awareness campaigns are needed to highlight these issues.

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1. Introduction:

Despite the worldwide progress in the research related to colorectal cancer (CRC), Merika et al. (2010) contend that this disease is "still responsible for about half a million mortalities yearly with a significant geographic variation in the global distribution of cases affected and depending on the way of life of the people and on their culture". In fact, the rates are higher in the developed countries, as asserted by Haggar and Boushey (2009), where "CRC risk factors including sedentary lifestyle, unhealthy eating habits, smoking, and obesity are closely linked to the Western culture". Globally, according to Lozano et al. (2012) in the year 2012, CRC was found to be the second most common cancer among females and the third among males, whereas in the United States, as reported by the American Cancer Society (2014a), "CRC was considered to be the third most common disease in both males and females". Likewise, similar to other parts of the world, for example, France, and Turkey, CRC was declared to be in third place after breast and prostate cancers (Denis, et al., 2003; Ozsoy et al., 2007). In 2015, the World Health Organization (WHO) identified

Colorectal Cancer (CRC) as the fourth leading cause of cancer-related deaths (694,000 deaths) after lung (1.59 million deaths), liver (745,000 deaths) and stomach (723,000 deaths) cancers.

While, in Lebanon, a study conducted by Shamseddine et al. (2014), examined the changes in cancer prevalence rates in the country between 2003 and 2008, and concluded that the age-standardized rates for CRC are 15.3 and 14.1 per 100,000 for males and females, respectively. Additionally, CRC ranked as the fourth most prevalent kind of cancer among males and the second among females. Moreover, according to the national cancer registry of the Lebanese Ministry of Public Health (MOPH), the frequency of reported incidents of CRC increase after the age of 60, with a mean age varying from 61 to 64 years in both males and females (Lebanese Ministry of Public Health, 2012). As for CRC awareness in Lebanon, there is a dearth if not absence in studies on this topic using a representative national sample.

In order to succeed in creating targeted and informative messages, the assessment of the knowledge of any community of the topic under study is highly needed (Christou & Thompson, 2012). Thus, the purpose of this study is to assess the awareness of the general Lebanese population of CRC symptoms, risk factors, and screening. So far, this study can be considered the first study concerned with this specific cancer especially that earlier studies on cancer knowledge and awareness of the Lebanese population have been mostly limited to breast cancer, as well as of the importance of regular screening for its detection.

The results of this study will help in designing informative programs implicating doctors and media to raise awareness through targeted messages which can be ameliorated by suitable cancer educational programs. Additionally, it will play an important role in increasing participation in and adherence to future screening projects that help in detecting CRC at very early stages when it is highly curable, and in reducing the global load of cancer which has increased lately according to Jemal et al. (2011).

2. Literature Review:

Research conducted on CRC has improved knowledge of the screening modalities and guidelines recognized by and applied in developed countries (Winawer et al., 2003). Boyle and Levin (2008) refer to the world cancer report which asserts that the detection of pre-malignant polyps at early stages is associated with an elevated probability of successful treatment. Furthermore, the authors highlight the 10th point of the recommendation of the European Code against Cancer which states that “both males and females should be involved in colorectal screening starting at the age of 50”. This code was introduced and then revised to be a set of guidelines that, if abided by, could lead to a decrease in cancer incidence and mortality (Boyle and Levin, 2008).

Actually, the American Cancer Society (2015), declares that the last two decades have witnessed a decrease in the rates of CRC; this is attributed to some awareness of the topic and an increased use of early screening tests advocated by most guidelines for both males and females, starting at the age of 50 years in the absence of any symptoms.

Moreover, the Society emphasizes that screening guidelines include traditional colonoscopy every 10 years, starting at the age of 50 years for the average risk people; yearly Fecal Immune Test (FIT), which uses antibodies to detect fecal blood specifically human hemoglobin; virtual colonoscopy; and, Fecal Occult Blood testing (FOBT) among others. Raising awareness and ensuring high involvement in early screening improves early detection of CRC. As a matter of fact, the importance of raising awareness of very early signs of CRC among the general public is stressed by the Cancer Reform Strategy (CRS), circulated by the Department of Health in 2007; an initiative was established as part of CRS to boost activities that promote early detection of cancer in the UK (UK Department of Health, 2007). Also, The National Bowel Screening Program (NBCSP) administers FOBT to people whose ages are between 60 and 74, which is normally followed by colonoscopy when the results are abnormal (Powell et al., 2011).

In a study conducted by Winawer et al. (1993), shows that colonoscopic removal of polyps of the patients, included in the study, have led to a decrease in the occurrence of CRC as compared to two other cohort studies of participants whose polyps were not removed. However, in spite of the agreement among the specialists in this field about the importance of screening, the awareness campaigns of colorectal cancer, its symptoms, risk factors and the knowledge of the existence of early screening are still not optimal: a great number of people are completely unaware of the presence of the latter and its importance in the protection against this highly preventable disease. In effect, screening leads to the detection and removal of precancerous polyps from the colon and rectum before the former becomes cancerous; or, at least in cancer identification at very early stages when survival rates are high (American Cancer Society, 2014b). This implies the prevention of around one-quarter of CRC deaths that occur yearly (Boyle & Levin, 2008).

Colorectal cancer screening is underutilized despite evidence that screening reduces mortality (Walsh et al., 2005). Likewise, it has been reported in

the CRC literature that the continued high colorectal cancer mortality rate is due to the underutilization of screening tests (Bean, 2005). On the other hand, other researchers tried to identify barriers for not doing CRC screening. Greenwald (2006), reported the "lack of awareness being at the top" ; Marshall et al., (2007) contend that people simply had "preferences for no screening", while Greenwald and Edwards (2010), contend that "it has been reported all over the globe that even though effective screening methods are widely available to detect precancerous polyps, CRC screening remains underused" (p. 349), and from a positive point of view, many articles and studies were published to highlight the importance of screening as a principal means for early CRC detection (Causey & Greenwald, 2011; Aparna, 2014; American Cancer Society, 2015), and according to Pisera et al., (2016), "screening by applying different medical approaches has shown that it is possible to reduce mortality and incidence from colorectal cancer".

Winawer et al. (2003) stress the fact that there is "a need for improving the rates of screening which rely not only on changes in the way of thinking of the patients but also on the doctors' attitudes and recommendations as well as on the material affordability or insurance coverage of the screening methods". Also, Christou and Thompson (2012), contend that the lack of CRC acquaintance is a possible barrier to an active involvement in screening as explained by the direct relationship between knowledge of the disease and the intention to screen.

A behavioral change can be achieved as a result of recommendations of early screening by doctors as well as through the media advertisements and campaigns, guided by scientific research and publications. In a study conducted by Thong et al. (2015), the researchers aimed to assess the effect of a national campaign carried on by the UK national bowel cancer awareness in 2012 which meant "to improve survival rates of CRC by raising awareness and urging early seeking of medical help by those who have symptoms". The aforementioned was done by "comparing the number of CRC cases diagnosed, the stage at the time of diagnosis as well as the number of cases corresponding to an identical time period in the year before the campaign" (Thong et al., 2015). The study concluded that the "total number of cases diagnosed in 2012, is almost double", showing that half of the cases could have remained otherwise undetected weren't it for the campaign (Thong et al., 2015).

3. Materials and Methods:

This study is exploratory using a quantitative and comparative analysis. It is based on a survey questionnaire distributed to a convenient sample of 1140 participants who were willing to participate. They were approached in public places, universities, entrances of the hospitals or places of work; it also follows a snowball approach such that potential participants volunteered to distribute and complete few surveys within their own social circles.

The sample size is estimated based on Cochran's formula (Hejase & Hejase, 2013),

N0 = [z2pq]/[e2]; the degree of confidence z =1.96, is set at 95% (i.e. type I error is set at 5%); the desired level of precision in the rate of awareness, "e", is selected to be 3%; the awareness proportion is chosen to be 50%, that is p = q = 0.50, so that the formula may provide the largest sample size due to the maximum variability. The entries lead to a sample size of 1,067. However, an actual 1,140 participants took part in the study.

Eligibility criteria for participation included being 18 years of age or older, of any profession other than medical doctors, and having no previous history of CRC. All participants were observed during the survey, and the questions were read to them if they were unable to read or understand written Arabic. The survey included questions related to risk factors, symptoms, and methods of screening. The majority of the questions are in multiple-choice format, and multiple answers per question are permitted when applicable. The first part of the questionnaire includes the detailed purpose of the study and the informed consent assuring the confidentiality and anonymity of the personal data as well as the optional participation; it specified the freedom of anonymous personal data (age, gender, marital status, and education level). The questionnaire is written in Arabic, which is the native language in the area of interest, and included a part pertaining to the level of participant's knowledge of said topic, followed by a demographic section.

The knowledge part of the instrument utilized, includes questions about methods and preference for the three screening tests (colonoscopy, virtual colonoscopy and fecal immunochemical test - FIT), risk factors and symptoms, while the second part is comprised of questions that elicit information about age, gender, marital status, place of residence, education level, and occupation. The level of education is categorized as a graduate, university, secondary or less than secondary; the social status is classified as single, married, divorced, separated, or widowed. Likewise, gender is grouped as female or male; while the employment status is specified as a worker, without work, housewife or retired. The place of residence is categorized depending on the place of residence according to the Lebanese governorate. Finally, age is left open so that a participant may fill the actual age. At a later stage, while analyzing the data, age is transformed and coded by decades: 18-27

years (young), 28- 37 years (adult), 38- 47 years (young middle age), 48-57 years (middle age), and more than 58 years (senior).

The instrument with a Cronbach's alpha of 0.76 was used after asking permission of the authors of a similar research (Omran et al., 2015), and was reviewed by a gastrointestinal medical doctor, head nurse and a well-published university professor for accuracy and validity. The feedback notes are mostly about the length of the questionnaire and replacing Fecal Occult Blood (FOB), and Flexible Sigmoidoscopy with FIT and virtual colonoscopy, respectively. The researchers adjusted the questionnaire, taking the remarks of said reviewers into consideration before it was pilot tested. The pilot study was run on a sample of 15 participants in order to test the implementation of data collection, the clarity, and comprehension of the questions, in addition to the time taken to complete the questionnaire. The developments came up to be highly satisfactory and the pilot data was disregarded.

Statistical Product and Service Solutions (SPSS) software V.23, an IBM product acquired by IBM in 2009 (Hejase & Hejase, 2013) is used to manage and analyze the data after being verified and coded. Descriptive statistics are carried out on all the questionnaire items, including frequencies and percentages in addition to means and standard deviations when appropriate and needed. Bivariate analysis is conducted using the chi-square test to investigate the dependency relationships between the variables with a p-value of 0.05 to be considered statistically significant.

4. Results and Findings:

4.1. Sample demographic features:

Results show that the mean age of the sample is 37.79 years (SD=15.045), 52% of the participants are females, and 47.9% are males. 51.3% of the respondents are married, 43.9% are single, and the remaining 4.8% are either divorced, separated or widowed. Likewise, 66.5% of the respondents are employed, 18.4% are unemployed, 13.3% are housewives, and 1.8% is retired. Moreover, 43.8% holds a university degree, 20% are graduate, 20.2% are with a secondary degree, and the remaining 15.9% has a less than secondary education. Finally, the prevalent place of residence is Beirut the capital with 39.8%, 21.5% lives in Mount Lebanon, 16% lives in the north, 14.55% lives in the south, and 8.1% lives in eastern Lebanon.

4.2. CRC awareness:

The results of this study underline the lack of knowledge of CRC, where the percentage of respondents that have never heard of it is 59.6%. Moreover, results reveal that among those who have heard of CRC, females are the majority (60%); likewise, among those who never heard of CRC, males are the majority (53.3%). The association between gender and having heard of CRC is analyzed using Pearson's chi-square test (p-value of 0.05 was set to test statistical significance). The test reveals a chi-square of 20.377 (p-value=0.000), indicating a significant dependence between familiarity with CRC and gender, thus supporting the fact that females happen to have a better level of awareness of CRC.

Further chi-square tests, depicted in Table 1, show that the familiarity response is significantly related to age, social status, residence, employment status and education.

Table 1: *Percentages of participants' familiarity with CRC.*

	Familiarity with CRC percentage distributions					Chi-Square
Age (40.4 %)	Young 11.1 %	Adult 9.1%	Young Mid. Age 6.5 %	Mid. Age 8.5%	Senior 5.2 %	25.164 (p=0.000)
Social Status (40.4 %)	Single 16.0 %	Married 22.8 %	Divorced 1.2 %	Separated 0.1 %	Widowed 0.3 %	16.274 (p=0.003)
Residence (40.4 %)	Beirut 19.0 %	Mount Leb. 9.2 %	South 5.1 %	North 6.1 %	Bekaa 1.0 %	43.896 (p=0.000)
Employment (40.4 %)	Employed 28.4 %	Unemployed 5.1 %	House wife 6.2 %	Retired 0.7 %		18.296 (p=0.000)
Education (40.4 %)	Graduate 9.9 %	University 19.0 %	Secondary 7.5 %	Below Secondary 4.0 %		27.683 (p=0.000)

In fact, findings of this study as per Table 1, reveal that elder participants (age above 38 years) are more likely to be unfamiliar with CRC. Likewise, married, employed and highly educated respondents have proven to be more aware of CRC.

4.3. Acquaintance with CRC screening:

As for familiarity with CRC screening among those who declare knowledge of CRC (460 respondents), the results underline the lack of knowledge of CRC screening, whereby the percentage of respondents that have heard of it while claiming that they are familiar with CRC does not exceed 57.17% (adding males and females' percentages) as depicted in Table 2. Furthermore, this same Table reveals that among those who have heard of CRC, females are the majority (36.53 %). This gender-familiarity with CRC screening dependence is confirmed by the chi-square value of 3.849 (p-value=0.050), indicating a significant dependence between familiarity with CRC screening and gender.

Table 2: *Percentages of participants familiar with CRC.*

Familiarity with CRC screening percentage distributions						Chi-Square
Age (57.17 %)	Young 11.1 %	Adult 9.1%	Young Mid. Age 6.5 %	Mid. Age 8.5%	Senior 0.43 %	25.164 (p=0.000)
Social Status (57.17 %)	Single 23.48%	Married 31.52%	Divorced 1.74%	Separated 0.0%	Widowed 0.44 %	2.004 (p=0.735)
Residence (57.17 %)	Beirut 27.83 %	Mount Leb. 11.52 %	South 8.48 %	North 7.83 %	Bekaa 1.52 %	5.905 (p=0.206)
Employment (57.17 %)	Employed 38.91 %	Unemployed 7.83 %	House wife 9.35 %	Retired 1.09 %		1.400 (p=0.705)
Education (57.17 %)	Graduate 18.70 %	University 26.30 %	Secondary 7.83 %	Below Secondary 4.35 %		27.809 (p=0.000)
Gender (57.17 %)	Male 20.65 %	Female 36.53 %	--	--		3.849 (p=0.050)

Other variables that influenced the participants' awareness of CRC screening included age ($\chi2$=25.164, p=0.000) and educational level ($\chi2$=27.809, p=0.000), where the older the participants are the more likely they are unfamiliar with CRC screening. Likewise, the percentages of CRC screening awareness are higher among the upper educational sectors of the sample. On the other hand, the study shows that knowledge of CRC screening is independent of the social status ($\chi2$= 2.004, p=0.735), the place of residence ($\chi2$= 5.905, p=0.206), and the employment condition ($\chi2$= 1.400, p=0.705), where p is larger than the standard error of 5%.

4.4. Understanding CRC risk factors:

As for awareness of risk factors, the questionnaire exposed age, family history, stress, smoking, alcohol, and overweight as the possible causes of CRC. Respondents were asked to select as many choices as they believe are relevant; the results show that the most commonly known risk factors for CRC are family history (47.8%), alcohol (37.8%), and smoking (37.2%). On the other hand, fewer respondents are aware of the risks due to overweight (26.7%), age (26.5%), and stress (11.3%). Moreover, the results reveal that 70 respondents (15.2%) who are aware of CRC reported that none of the aforementioned items is a known CRC risk factor, while only 11 respondents (2.4%) confirm that all items are commonly known to be risk factors. Likewise, 130 respondents (28.2%) reported that only one of the items is a familiar risk factor while the majority of respondents, who claim awareness (136 participants, 29.5%), selected only two CRC risk items.

In fact, the aforementioned factors are associated with increased risk of CRC. For example, a study by Baron et al. (1998) stated that "seven or more drinks per week of alcohol intake was associated with increased risk of CRC". Moreover, Chao et al. (2000) concluded that long-term cigarette smoking is associated with increased risk of CRC mortality in both men and women.

Results also portray that knowledge of all the risk factors, except for family history, are not dependent on the respondent's gender (all corresponding p-values are above the significance level of 5%). Nevertheless, the relation between family history as a relevant risk factor and gender show a significant dependence (p-value=0.000), indicating that women (33.3%) are more likely to know about this specific link than men (14.5%) do. Here, results do not agree completely with what has been reported in that male respondents are more likely to give correct answers in relation to the main risk factors as reported by Al Wutayd et al., (2015). On the other hand, the reported results do agree with results of a study done in the USA showing that females have higher levels of knowledge of CRC (Aparna, 2014).

Other variables that influenced the participants' answers include higher educational levels, family history of CRC, and knowledge of the CRC correct definition; in addition, those practicing regular physical activity have modified it (physical activity) due to the fear of contracting the disease. These findings are in agreement with the results incurred by the majority of previous studies carried out to explore what correlates with knowledge of cancer in general and CRC in particular, among the general population, worldwide (Al Wutayd et al., 2015; Aparna, 2014). The findings of the current work show that 37% of participants believe that it is possible to prevent CRC; this can have implication on designing and implementing health campaigns to address the preventability of the disease.

Similar cross analysis of risk factors in relation to age category, social status, and employment condition demonstrate the absence of any significant relation between any of them and each of all aforementioned risk items (all p-values > 5%). On the other hand, a statistically significant relation is identified between the knowledge of CRC risk items and educational level. As a matter of fact, results show that the highly educated respondents link CRC risk to family history ($\chi2$= 19.331, p=0.000), while the few (11.3%) that believe that stress is linked to CRC are in general of a higher educational background ($\chi2$= 9.14, p=0.027).

As for the relation between the place of residence and awareness of risk factors, results disclose that all risk factors are not related to the place of residence except that of smoking where a significant link exists between the place of residence and the belief that smoking is a CRC risk factor ($\chi2$= 17.995, p=0.021). Further analysis shows that residents of the capital tend to agree more on that smoking is a significant CRC risk factor.

4.5. Respondents who were up-to-date with CRC screening:

On the matter of CRC screening, the percentage of respondents who are aware of CRC have done colonoscopy screening amounts to10.80%; while, the percentage of those who have done virtual colonoscopy amounts to only 1.1%. Also, the questionnaire results reveal that the percentage of aware respondents who have done a Fecal Immune Test (FIT) to detect fecal blood amounts to 4.8%.

Undeniably, the aforementioned results coincide with the low rates of colorectal cancer screening among African Americans, where researchers continue issuing calls calling for educating persons more about CRC before the age of 50 (Powe & Finnie, 2006).

4.6. CRC information sources:

As for the sources of information about CRC, the Internet and information media (radio and television) are listed as the most frequent source of information about cancer. The percentages of respondents who named these two as their source of information are 29.9% and 22.6%, respectively. Other sources of information are listed and chosen such as the family doctor (18.9%) and friends (18.4%). The family member (2%), nurse (5.4%) and magazines (3.5%) are the least chosen.

4.7. Respondents' awareness of CRC symptoms:

Table 3 shows that respondents are aware of and able to recognize the symptoms associated with CRC, including bloating, blood in stool, change in bowel movement, gases, diabetes, sedentary lifestyle and disease in digestive tract; these symptoms are in general independent (at 5% level of significance) of the respondents' age, gender, educational level, social status, place of residence and employment, except for the six occurrences that are highlighted. Undeniably, it is clear that the respondents' six opinions on the bloating symptom are related to the place of residence, namely, Mount Lebanon, North, and Bekaa; the percentage of respondents that are aware of bloating as a symptom and those that are unaware are nearly the same (or almost similar). However, these percentages do differ significantly in the region of Beirut, where 32.4% of the respondents are aware (67.6% unaware); likewise, in the south, 25.9% of the respondents are aware (74.1% unaware). Similarly, opinions related to the diabetes symptom are affected by the respondents' region where the percentage of respondents affirming the relation of CRC with diabetes does not exceed 3.4% in all regions except in the North where 11.6% of the respondents believe that there is a connection between diabetes and CRC.

Table 3: *Dependencies associated with CRC symptoms.*

Symptom	Age	Gender	Education	Social Status	Residence	Employment
Bloating	χ^2= 6.362 p=0.174	χ^2= 4.946 p=0.176	χ^2= 3.531p=0.317	χ^2= 4.051 p=0.399	***χ^2= 10.777 p=0.029***	χ^2= 1.527 p=0.676
Blood in stool	χ^2= 1.419 p=0.841	***χ^2= 4.672 p=0.031***	***χ^2= 17.647 p=0.001***	χ^2= 2.971 p=0.563	χ^2= 9.327 p=0.053	***χ^2= 8.091 p=0.044***
Change in bowel movement	χ^2= 8.183 p=0.085	χ^2= 2.693 p=0.101	χ^2= 4.946 p=0.176	χ^2= 3.298 p=0.509	χ^2= 2.082 p=0.721	χ^2= 6.048 p=0.109
Gases	χ^2= 2.639 p=0.620	χ^2= 1.755 p=0.185	χ^2= 5.843 p=0.120	χ^2= 7.287 p=0.121	χ^2= 2.633 p=0.621	χ^2= 2.524 p=0.471
Diabetes	χ^2= 6.221 p=0.183	χ^2= 0.034 p=0.855	χ^2= 2.397 p=0.494	χ^2= 7.550 p=0.110	***χ^2= 11.652 p=0.020***	χ^2= 1.039 p=0.792
Sedentary lifestyle	χ^2= 2.405 p=0.662	χ^2= 0.019 p=0.891	χ^2= 5.630 p=0.131	χ^2= 4.226 p=0.376	χ^2= 4.610 p=0.330	χ^2= 2.460 p=0.483
Disease in digestive tract	χ^2= 7.488 p=0.112	χ^2= 0.546 p=0.460	***χ^2= 20.115 p=0.000***	χ^2= 6.723 p=0.151	χ^2= 7.855 p=0.097	χ^2= 3.303 p=0.347

The relationship between the symptom "blood in stool" and CRC came up as significant under the respondents' gender, education and employment. As a matter of fact, 62.3% of the 276 females, aware of CRC, have assured the existence of a relationship between CRC and "blood in stool"; this percentage is only 52.2% of the 184 of males who are aware of CRC. Under education, the results reveal that percentages of respondents' opinions that relate "blood in stool" to educational level are significantly different, being 70.8% for graduates, 57.9% for university level, 41.2% for secondary level, and 60.9% for those below secondary. In fact, 41.4% of those who are employed are aware of CRC relation to "blood in stools", while in the three other categories, employed but are not aware of CRC, housewife and retired, the percentages are approximately identical: being 61.3%, 57.7%, and 62.5% respectively. The findings of this study concur with other studies' reporting on this topic. In a study conducted by Manning et al. (2006), "only 26.6% of outpatients afflicted by CRC could name a symptom of colorectal cancer manifestation". Moreover, in Iran, in a study conducted by Bidouei et al. (2014), the results established that "more than 90% did not have any prior awareness of CRC risk factors, symptoms or the screening tests".

4.8. Readiness for CRC screening:

The respondents' inclinations towards non-readiness for screening tests in relation to their demographics are presented in Table 4. Results reveal that demographics (like gender, education, social status, residence, and age) except for the employment

level and readiness to perform the CRC screening, are independent and not related at a 5% level of statistical significance as evidenced by the corresponding chi-squared values. Actually, the analysis of the data unveils that unemployment and the preferences of subjects who are aware of CRC screening are dependent at 5% level of significance. Results show that 80.76% of the respondents who are unemployed are aware of CRC screening, while the categories employed, housewife and retired who are aware score 70.90%, 66.20%, and 25% respectively.

Table 4: *Non-readiness for screening tests in relation to demographics.*

No CRC screening preference percentage distributions						χ^2
Gender (29.13 %)	Female 50 (10.87%)			Male 84 (18.26%)		χ^2= 0.569 p=0.451
Social Status (29.13 %)	Single No: 9.78 %	Married No: 18.26 %	Divorced 1.09 %	Separated 0 %	Widowed 0 %	χ^2= 4.920 p=0.296
Education (29.13 %)	Graduate 6.74 %	University 12.83 %	Secondary 6.52 %	Below Secondary No: 3.04 %		χ^2= 2.105 p=0.551
Residence (29.13 %)	Beirut 11.95 %	Mount Leb. 8.70 %	South 4.13 %	North 3.48 %	Bekaa 0.87 %	χ^2= 7.038 p=0.134
Employment (29.13 %)	Employed 20.44 %	Unemployed 2.17 %	Housewife 5.22 %	Retired 1.30 %		χ^2= 12.875 p=0.005
Age (29.13 %)	Young 5.87 %	Adult 6.74%	Young Mid. Age 4.35%	Mid. Age 7.39%	Senior 4.78 %	χ^2= 7.489 p=0.112

This study shows that the respondents who reported to be aware of CRC were asked the classical question "Are you ready to do screening even with the absence of symptoms, knowing that early screening may prevent colorectal cancer?" The results reveal that 29.13% of the respondents expressed their preference for no screening. This percentage surprisingly coincides with the results of a Canadian study where almost 30% of the participating subjects preferred no screening (Marshall et al., 2007).

4.9. Reducing CRC risk:

Data related to the beliefs, plans and intentions of the respondents to act in order to diminish the risks of being diagnosed with CRC is collected through the question: Do you think you can reduce the risk of CRC?

The answers for this binary question (yes/no) are collected from the 460 respondents who claim to be acquainted with CRC. Two opinions became clear: 363 (78.91%) respondents agree with the statement that they may reduce the risk of CRC, and the second group forming the remaining 97 (21.09%) stated that they are unable to reduce the CRC risk. Furthermore, the bivariate dependency chi-square tests reveal that answers to the question "Do you think you can reduce the risk of CRC?" are independent of the aware respondents' demographics features related to gender, social status, place of residence, employment status and age (all tests presented independency at 5% level of significance each with a p>0.05). However, the relation between the aforementioned question and educational level did exhibit dependency (χ2= 12.960, p=0.005); this is due to the fact that highly educated respondents who are aware of CRC expressed faith in being able to reduce CRC risk (86.72% of the graduates and 81.02% of the university level agreed), while those holding a high school educational level or below are less optimistic (68.24% of the secondary level and 69.57% of the below secondary level agreed).

4.10. Respondents' relatives diagnosed with CRC:

Among the 460 participants who are aware of CRC, 104 (22.6%) reported that they have relatives diagnosed with CRC. Moreover, a significant chi-square test dependence (χ2= 5.433, p=0.020) is obtained between the question: "Are you ready to do screening even with the absence of symptoms, knowing that early screening may prevent colorectal cancer?" and the question: Do you have any relatives diagnosed with CRC? In fact, the results show that only 20.19% of those who have relatives diagnosed with CRC expressed their unwillingness to do CRC screening in comparison to 32.02% of those who do not have relatives diagnosed with CRC. Furthermore, the participants' relatives diagnosed with CRC have for their age mean 55.66 years, median 57 years, mode 60 years, and SD 12.44 years. The aforementioned results agree with Power et al. (2011) findings, which reveal that knowing someone who has been diagnosed with cancer is associated with higher awareness.

4.11. Readiness to screen for CRC in the future

The classical question that is usually influenced by respondents' barriers to colorectal cancer screening is: Are you ready to do screening even with the absence of symptoms, knowing that early detection may stop this disease?

The CRC-aware respondents were asked if in the future they have any plans to perform any of the popular CRC screening methods, mainly FIT, colonoscopy or virtual colonoscopy. The collected responses show upsetting results whereby those who would carry out any of the CRC screening tests do not exceed 23% of the total CRC-aware respondents (FIT, 22%; Colonoscopy, 22.7%; and Virtual Colonoscopy 15.5%).

The disappointing results may trigger selected national programs and services that are focused on increasing awareness of CRC. In fact, colorectal cancer-related information should target the whole population before age 50, using multiple sources such

as TV/radio, NGOs, providers, magazines, and cancer-related organizations.

5. Discussion:

A very small number of CRC-aware participants know that diabetes (4.14%), sedentary lifestyle (8.48%) could lead to CRC. Moreover, relatively few CRC-aware participants are able to identify gases (15.22%) and changes in bowel habits (28.70%), as other common symptoms. On the other hand, the CRC-aware respondents are more familiar with 'blood in stools' (58.26%) bloating (36.50%) and diseases in the digestive tract (31.30%) as symptoms for CRC.

Additionally, the risk factors are not well known even among the highly educated CRC- aware participants where only 11.30% agree that stress could be a risk factor. Furthermore, those same CRC-aware respondents have modest information as to what relates to the other risk factors, mainly age (26.50), obesity (26.70 %), smoking (37.2 5), and alcohol (37.5 %). The family history is the more familiar risk factor (47.8 %); however, women outperformed men in what relates to identifying family history as a serious risk.

Knowing someone with CRC is associated with higher awareness of CRC symptoms, but not risk factors. This is not that surprising given that increased exposure to CRC is likely to be associated with greater awareness of the disease and its presenting symptoms and less so with the causal processes involved. Having a family history of CRC could be more strongly associated with knowledge of risk factors due to increased perceptions of risk and motivations to prevent the disease (Redeker et al., 2009; Power et al., 2011).

At this level of this discussion, it is worth presenting some of the written statements by some of the CRC participants who commented in this study:

1) If I had the money, I would have had a CRC screening.
2) Family members were hit by CRC. Our doctor didn't tell us to do CRC screening.
3) Our doctor did not tell us to screen.
4) the family doctor did not tell the family about the screen.
5) Pollution is another risk factor but doctors do not advise us to the screen.
6) I do not have the money to do a CRC screening.

This research confirms that an important factor for encouraging CRC screening is a recommendation from a personal physician. This same finding was reached in different studies like that applied to an African-American sample (Wilkins et al., 2012). Why physicians refrain from recommending CRC screening? Is it because of the associated complications of the colonoscopies? The responses should not bring fear because one study was conducted on 15,228 colonoscopies (3968 were done for average risk screening) resulted in only two intestine perforations (0.05%) and six polypectomy bleedings (0.15%); there was no mortality. Therefore, Colonoscopy is safe (Spellman et al., 2007).

Moreover, the aforementioned written comments shed light on the financial barriers associated with CRC screening. Even though many private insurance plans cover the costs for colonoscopy as a screening test, an individual still might be charged for some services like anesthesia, the bowel prep kit, pathology costs, and a facility fee (American Cancer Society, 2014). Actually, the cost has been always one of the common barriers among other factors like attitudes, beliefs, health care providers and systems (Knight et al., 2015).

The respondent's comments are just a few quotes that should guide the awareness campaigns in two directions: First to concentrate on communicating messages about cancer symptoms and risk factors to unaware medical doctors themselves and make them familiar with the details of CRC concepts, vocabulary, and jargon in general. Secondly, campaigns should be directed to the general public to raise the levels of CRC awareness of symptoms and risk factors in order to create more positive attitudes towards CRC screening, thus reducing the percentages of mortality. Similar findings are obtained in a study conducted by (Qumseya, et al., 2014), where the researchers pinpointed two main factors related to the low rates of CRC screening in the population of their study: "public awareness and the death in the recommendations or advice of the physicians about the importance of early CRC screening". The current research highlights the desperate need to initiate CRC screening programs within the Lebanese health care system. According to a study done by Boyle and Levin (2008), world cancer report, up to 33.3% of new cancers could be discovered at an early stage especially with the improvement of awareness for early symptoms as well as for early detection and screening techniques.

6. Limitations:

This research has some relevant limitations that should be clearly presented to the reader. Apart from using a convenience sample, selection bias may have been present as only those who are in the researchers' circles were asked to fill out the questionnaires. However, it is worth mentioning that even though selection bias could have affected the findings, these findings are very similar to other studies with comparable groups (Shokar et al., 2005; Ahmad, 2014).

The answers collected from the respondents are self-reported and may have caused the participants to provide inaccurate responses or handing in socially desirable replies; such an incident is very popular in survey research (Hejase & Hejase, 2013). Another limitation of the sample is its biased educational level. Though 20% of the research participants hold a Master's or advanced degree, and another 43.8% have a university level education, yet such characteristics are not typical of the Lebanese general public. Moreover, the results of this study show that the educational level and the CRC awareness are in fact dependent on the fact that the participants that are aware of CRC constituted 49.6% of graduates, 43.3% of university levels, 37.0% of secondary holders, and 25.4% of respondents who have less than secondary education.

Regardless of these aforementioned limitations, the present research does offer an indispensable contribution to start understanding the Lebanese public views of CRC and CRC screening. Colorectal cancer can be prevented by diet and lifestyle, in addition to polypectomy, and the morbidity and mortality can be reduced by early (Racial Disparities and Barriers to Colorectal Cancer Screening in Rural Areas). As the disease no one has to die from (Pochapin, 2004), the Lebanese public ought to learn that CRC is a preventable and treatable disease when early detection occurs. That's why there should be a nationwide public awareness campaign that highlights and makes known the CRC symptoms and risk factors which in this study attained a maximum of 58.26% (minimum 4.14%) for recognizing a symptom and a maximum 47.8% (minimum 11.3%) for being aware of a risk factor.

7. Conclusion:

Lebanon is a country that relatively runs the same health policies as those in other countries like Turkey where the healthcare services are mainly curative rather than preventive and rehabilitative (Ozsoy et al., 2007). In essence, even though the Lebanese Ministry of Health provides modest healthcare services for prevention and early detection of CRC, their availability and accessibility for the general public are very low. Moreover, the Ministry should work on encouraging dietary reformations aimed at preventing CRC. Two studies performed in the USA (Kim, 2000), and the UK (Khong et al., 2015) estimated that 50–75% of CRC may be prevented by dietary modifications. For example, the consumption of natural garlic has been extensively recommended as a dietary means that offers protection against cancer (Fleischauer and Arab, 2001).

It is natural that screening programs should call upon healthy individuals with no previous symptoms. Therefore, screening programs to be widely spread in Lebanon have the responsibility to secure the highest quality standards in what relates to high standards, safe procedures and satisfactory experiences (Ouyang et al., 2005).

Thus, an effective quality assurance is needed to guarantee that the benefits of screening (better survival and quality of life) outweigh the harms (false negative result, false positive, complications related to colonoscopy as perforation or lower gastrointestinal bleeding) (Barrett & McKenna, 2011; Dreier et al., 2014).

Finally, the following recommendation is to be spread to encourage further research in the CRC area: "We need to systematically evaluate interventions to increase screening adherence, identify predictors of screening uptake, and identify the reasons for nonadherence" (Rabeneck, 2007).

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