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Awareness of Lung Cancer Risk Factors in Palestine: Current Situation and Future Directions

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1 **Awareness of Lung Cancer Risk Factors in Palestine: Current Situation and Future**
2 **Directions**

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1

1 **Abstract**

2 **Objectives:** To evaluate the awareness of lung cancer (LC) risk factors among Palestinians and

3 identify factors associated with good awareness.

4 **Design:** Cross-sectional study.

5 **Settings:** Participants were recruited using convenience sampling from hospitals, primary

6 healthcare centers, and public spaces located at 11 governorates in Palestine.

7 **Participants:** Of 5174 approached, 4817 participants completed the questionnaire (response

8 rate= 93.1%). A total of 4762 questionnaires were included in the analysis: 2742 from the West

9 Bank and Jerusalem (WBJ) and 2020 from the Gaza Strip. Exclusion criteria were working or

10 studying in a health-related field, having a nationality other than Palestinian, and visiting

11 oncology departments or clinics at the time of data collection.

12 **Primary and secondary outcome measures:** The primary outcome was the awareness level of

13 LC risk factors, which was determined by the number of factors recognized: poor(0 to 3), fair(4

14 to 7), and good(8 to 10). Secondary outcomes include the recognition of each LC risk factor.

15 **Results:** Smoking-related risk factors were more often recognized than other LC risk factors.

16 The most recognized risk factors were 'smoking cigarettes'(n=4466, 93.8%) and 'smoking

17 shisha [waterpipes]'(n=4337, 91.1%). The least recognized risk factors were 'having a close

18 relative with LC'(n=2084, 43.8%) and 'having had treatment for any cancer in the past'(n=2368,

19 49.7%).

20 A total of 2381 participants (50.0%) displayed good awareness of LC risk factors. Participants

21 from the WBJ and the Gaza Strip had a similar likelihood to display good awareness (50.6% vs.

2

1   49.1%). Being ≥45 years, having higher education and monthly income, knowing someone with

2   cancer, and visiting hospitals and primary healthcare centers were all associated with an increase

3   in the likelihood of displaying good awareness.

4   **Conclusion:** Half of study participants displayed good awareness of LC risk factors. Effective

5   implementation of tobacco control policies is essential beside educational initiatives to improve

6   public awareness of LC risk factors.

7   **Keywords:** lung cancer, risk factors, behavioral changes, prevention, early detection, early

8   diagnosis, health education, awareness, Palestine.

9   **Strengths and limitations of this study**

10   • This study used a translated version of a validated tool (lung cancer awareness measure)

11   to assess the awareness of LC risk factors in Palestine.

12   • The large sample size and high response rate were major strengths of this study.

13   • The wide coverage of the major geographical areas of Palestine and collecting data from

14   different places within each area allowed for direct evaluation of the knowledge of LC

15   risk factors at various levels in the Palestinian population.

16   • The use of convenience sampling does not guarantee the generalizability of the findings.

17   • Visitors or patients in the oncology departments as well as those with medical

18   backgrounds were all ineligible, which might have reduced the number of participants

19   with a presumably good awareness.

3

1 **Introduction**

2 Lung cancer (LC) is the leading cause of cancer-related deaths worldwide with 18.0% of cancer-

3 related deaths and over 2.2 million newly diagnosed cases in 2020.[1] In the Middle East and North

4 Africa, the estimated number of newly diagnosed LC cases was 79,887 in 2018 with a 5-year

5 relative survival rate of 8.0%.[2] In Palestine, LC is the second most common cancer, accounting for

6 11.4% of all cancers with an incidence rate of 11.5 per 100,000 general population, and the leading

7 cause of cancer-related mortality accounting for 17.3%.[3]

8 The most significant risk factor for LC is smoking tobacco products including cigarettes and shisha

9 (waterpipes).[4] Tobacco smoking was reported to be prevalent among 47.7% of Palestinians in the

10 West Bank. Men were found to smoke more than women and to begin smoking at an earlier age,

11 where 74.4% of smokers started when they were 18 years old or younger. Cigarettes and shisha

12 were found to be the most popular methods of smoking among Palestinian men and women.[5]

13 Besides smoking, there are LC risk factors for LC, such as exposure to radiation, occupational

14 hazards like asbestos, air pollution and family history of LC.[6-8] However, previous studies

15 showed that awareness of smoking-related risk factors of LC was higher than that of other LC

16 risk factors.[9-11]

17 One of the most important contributors to the low survival rates of LC is delayed presentation.

18 This could be due to factors related to patients, healthcare providers, the healthcare system, or

19 the disease itself.[12] Awareness of LC risk factors is one of the patient-related factors.

20 Recognition of LC risk factors can help stimulating the development of an active personal risk

21 assessment, which in turn increases the ability to detect and react to related symptoms.[13]

4

1 Previous studies demonstrated that raising the public awareness of LC increased the number of

2 individuals diagnosed at early stages.[14-16] An early diagnosis of LC contributes to better

3 prognosis.[17] Given the limited resources in Palestine, such educational interventions could be an

4 efficient strategy to mitigate the mortality associated with LC.

5 Therefore, this national study aimed to (i) evaluate the awareness level of LC risk factors among

6 Palestinians, (ii) examine if there is a difference in the awareness level of LC risk factors

7 between the two main areas of Palestine: the West Bank and Jerusalem (WBJ) and the Gaza

8 Strip, and (iii) identify the factors associated with good awareness.

9 **Methods**

10 *Study design and population*

11 This was a national cross-sectional study conducted from July 2019 to March 2020. Palestinian

12 adults ($\geq$ 18 years) were the target population. Participants were recruited from governmental

13 hospitals, primary healthcare centers (PHCs) and public spaces, such as malls, markets,

14 restaurants, mosques, churches, parks, downtowns, transportation stations and others. Exclusion

15 criteria were working or studying in a health-related field, having a nationality other than

16 Palestinian, and visiting oncology departments or clinics at the time of data collection.

17 *Sampling methods*

18 Eligible participants were recruited to the study using a convenience sampling technique from

19 governmental hospitals, PHCs, and public spaces located in 11 governorates (out of 16) across

20 Palestine. This was intended to create a diverse study cohort resembling the Palestinian

21 community.[18-20]

5

1   *Questionnaire and data collection*

2   A modified version of the LC Awareness Measure (LCAM) was used for data collection. The

3   LCAM is a validated tool that was designed to evaluate the public awareness of LC.[13] The

4   original LCAM was first translated into Arabic by two bilingual healthcare professionals and

5   then back-translated into English by another two different bilingual healthcare professionals. The

6   Arabic version of the LCAM was then assessed for content validity and accuracy of translation

7   by three experts in the field of thoracic oncology, public health, and survey design. This was

8   followed by a pilot study (n= 68) to assess the clarity of questions in the Arabic version of the

9   BCAM. The questionnaires of the pilot study were not included in the final analysis. The

10   Cronbach's Alpha was used to assess the internal consistency of the Arabic LCAM and it

11   reached an acceptable value of 0.784.

12   The Arabic LCAM included two sections. The first section described the sociodemographic

13   factors of study participants. The second section evaluated the awareness of 10 LC risk factors

14   using a 5-point Likert scale (1=strongly disagree, 5=strongly agree). Of the 10 risk factors, nine

15   were mentioned in the original LCAM.[13] 'Smoking shisha' was added to the questionnaire as it

16   was deemed important to assess the awareness of this risk factor in the Palestinian community

17   due to its high prevalence.[5]

18   The electronic tool 'Kobo Toolbox' was utilized in the data collection.[21] This safe tool can be

19   used both offline and online on mobile devices. In a face-to-face interview, participants were

20   asked to complete the questionnaire. Data collectors with a medical background received special

21   training on the use of Kobo Toolbox, recruitment of potential study participants, gaining

22   informed consent, and facilitation of completion of the questionnaires.

23

1   *Statistical analysis*

2   The percentage of new LC cases increases substantially starting from the age of 45.[22] Therefore,

3   participants' age was categorized into two categories using this cutoff: 18-44 years and ≥45 years.

4   The monthly income was also categorized into two categories (<1450 NIS and ≥1450 NIS) since

5   1450 NIS (about $450) is the minimum wage in Palestine.[23]

6   The median and interquartile range (IQR) were used to describe continuous, non-normally

7   distributed variables and the Kruskal-Wallis test was used for baseline comparisons. Frequencies

8   and percentages were used to describe categorical variables and Pearson's Chi-square test was used

9   for baseline comparisons.

10   The recognition of each LC risk factor was assessed using a question based on a 5-point Likert

11   scale with 'strongly agree' or 'agree' as a correct answer, and 'strongly disagree', 'disagree', or

12   'not sure' as an incorrect answer. For each correctly recognized LC risk factor, one point was

13   given. LC risk factors were further categorized into two categories: (i) smoking-related and (ii)

14   other risk factors. Recognition of LC risk factors was described using frequencies and percentages

15   with comparisons performed by Pearson's Chi-Square test. This was followed by running

16   bivariable and multivariable logistic regression analyses to examine the association between

17   recognizing each LC risk factor and participant characteristics. The multivariable analysis adjusted

18   for age group, gender, educational level, monthly income, occupation, place of residency, marital

19   status, having a chronic disease, knowing someone with cancer, smoking history, and site of data

20   collection. This model was determined a priori based on previous studies.[13, 24-27] The results of the

21   bivariable analyses are provided in the supplementary materials, please see additional file 1.

7

1 A scoring system was used to evaluate the participants' awareness level of LC risk factors. Similar

2 scoring systems were also used in previous studies.[18, 27, 28] For each correctly recognized LC risk

3 factor, one point was given. The total score (ranging from 0 to 10) was calculated and categorized

4 based on the number of recognized LC risk factors into three categories: poor (0 to 3), fair (4 to

5 7), and good awareness (8 to 10). The awareness level of LC risk factors exhibited by participants

6 from the Gaza Strip was compared with the awareness level exhibited by participants from the

7 WBJ using Pearson's Chi-Square test. Bivariable and multivariable logistic regression analyses

8 were utilized to test the association between participant characteristics and having a good

9 awareness level.

10 Complete case analysis was used to handle missing data, which occurred completely at random.

11 Data were analyzed using Stata software version 16.0 (StataCorp, College Station, Texas, United

12 States).

13 *Patients and public involvement*

14 There was no patient or public involvement in conducting this study. There are no plans to

15 disseminate the results of our research to study participants. However, results are being

16 disseminated among the professional communities of Palestine and to policy-makers, with the

17 intent to inform future health policy decisions.

18 **Results**

19 *Participant characteristics*

20 Of 5174 approached, 4817 participants completed the questionnaire (response rate= 93.1%). In

21 total, 4762 questionnaires were included in the analysis (24 were ineligible and 31 had missing

22 data): 2742 from the WBJ and 2020 from the Gaza Strip. The median age [IQR] for all

8

1 participants was 32.0 years [24.0, 44.0] (table 1). Participants living in the WBJ were more likely

2 to be older, have higher monthly income but lower level of education, and suffer from more

3 chronic diseases than participants living in the Gaza Strip.

Table 1: Characteristics of study participants.

Characteristic	Total (n= 4762)	Gaza Strip (n= 2020)	WBJ (n= 2742)	p-value
Age, median [IQR]	32.0 [24.0, 44.0]	30.0 [24.0, 40.0]	34.0 [24.0, 47.0]	<0.001
Age group, n (%)				<0.001
18 to 44	3572 (75.0)	1634 (80.9)	1938 (70.7)	
45 or older	1190 (25.0)	386 (19.1)	804 (29.3)	
Female gender, n (%)	2618 (55.0)	1086 (53.8)	1532 (55.9)	0.15
Educational level, n (%)				
Secondary or below	2375 (49.9)	955 (47.3)	1420 (51.8)	0.002
Post-secondary	2387 (50.1)	1065 (52.7)	1322 (48.2)	
Occupation, n (%)				
Unemployed/housewife	2003 (42.1)	970 (48.0)	1033 (37.7)	<0.001
Employed	2160 (45.4)	814 (40.3)	1346 (49.1)	
Retired	111 (2.3)	46 (2.3)	65 (2.4)	
Student	488 (10.2)	190 (9.4)	298 (10.8)	
Monthly income ≥ 1450 NIS, n (%)	3241 (68.1)	683 (33.8)	2558 (93.3)	<0.001
Marital status, n (%)				
Single	1480 (31.1)	641 (31.7)	839 (30.6)	0.07
Married	3117 (65.5)	1323 (65.5)	1794 (65.4)	
Divorced/Widowed	165 (3.5)	56 (2.8)	109 (4.0)	
Having a chronic disease, n (%)	1032 (21.7)	313 (15.5)	719 (26.2)	<0.001
Knowing someone with cancer, n (%)	2571 (54.0)	1045 (51.7)	1526 (55.7)	0.007
Ever smoked, n (%)				
Cigarettes	1127 (23.7)	417 (20.6)	710 (25.9)	<0.001
Shisha (waterpipes)	499 (10.5)	142 (7.0)	357 (13.0)	<0.001
Site of data collection, n (%)				
Public Spaces	1920 (40.3)	784 (38.8)	1136 (41.4)	<0.001
Hospitals	1628 (34.2)	651 (32.2)	977 (35.7)	
Primary healthcare centers	1214 (25.5)	585 (29.0)	629 (22.9)	

n= number of participants, IQR= interquartile range, WBJ= West Bank and Jerusalem.

9

1 *Recognition of LC risk factors*

2 Smoking-related risk factors were more often recognized than other LC risk factors. The most

3 frequently identified risk factors were 'smoking cigarettes' (n= 4466, 93.8%) and 'smoking

4 shisha' (n= 4337, 91.1%) (table 2). These risk factors were the most identified in both the WBJ

5 and the Gaza Strip. The least recognized risk factors were 'having a close relative with LC' (n=

6 2084, 43.8%) and 'having had treatment for any cancer in the past' (n= 2368, 49.7%). These risk

7 factors were also the least identified in both the WBJ and the Gaza Strip.

Table 2: Recognition of lung cancer risk factors.

Factor	Total (n= 4762) n (%)	Gaza Strip (n= 2020) n (%)	WBJ (n= 2742) n (%)	p-value
Smoking-related risk factors				
Smoking cigarettes	4466 (93.8)	1892 (93.7)	2574 (93.9)	0.77
Smoking shisha	4337 (91.1)	1822 (90.2)	2515 (91.7)	0.07
Exposure to another person's cigarette smoke	3867 (81.2)	1621 (80.2)	2246 (81.9)	0.15
Other risk factors				
Air pollution	3838 (80.6)	1543 (76.4)	2295 (83.7)	<0.001
Exposure to chemicals (e.g., asbestos)	3802 (79.8)	1582 (78.3)	2220 (81.0)	0.024
Exposure to radiation	3788 (79.6)	1598 (79.1)	2190 (79.9)	0.52
Having a previous history of lung disease (e.g., COPD)	3216 (67.5)	1382 (68.4)	1834 (66.9)	0.27
Having a previous history of cancer such as head and neck cancer	2778 (58.3)	1165 (57.7)	1613 (58.8)	0.43
Having had treatment for any cancer in the past	2368 (49.7)	1020 (50.5)	1348 (49.2)	0.36
Having a close relative with lung cancer	2084 (43.8)	832 (41.2)	1252 (45.7)	0.002

n= number of participants. WBJ= West Bank and Jerusalem, COPD= chronic obstructive pulmonary disease.

10

1   *Good awareness and its associated factors*

2   A total of 2381 participants (50.0%) displayed good awareness (prompt recognition of more than

3   seven out of 10 LC risk factors) (table 3). Participants from the WBJ and the Gaza Strip had a

4   similar likelihood to display good awareness (50.6% vs. 49.1%). On the multivariable analysis,

5   being $\geq$ 45 years, having higher education and monthly income, knowing someone with cancer,

6   and visiting hospitals and PHCs were all associated with an increase in the likelihood of having a

7   good awareness level of LC risk factors (table 4).

Table 3: Awareness level of lung cancer risk factors among study participants.

Level	Total n (%)	Gaza Strip n (%)	WBJ n (%)	p-value
Poor (0-3 risk factors)	203 (4.3)	111 (5.5)	92 (3.4)	
Fair (4-7 risk factors)	2178 (45.7)	918 (45.4)	1260 (46.0)	0.001
Good (8-10 risk factors)	2381 (50.0)	991 (49.1)	1390 (50.6)	

n= number of participants, WBJ= West Bank and Jerusalem.

Table 4: Bivariable and multivariable logistic regression analyzing factors associated with having a good awareness of lung cancer risk factors.

Characteristic	Good awareness			
	COR (95% CI)	p	AOR (95% CI)*	P
Age group				
18 to 44	Ref	Ref	Ref	Ref
45 or older	1.33 (1.17- 1.52)	<0.001	1.20 (1.02- 1.42)	0.026
Gender				
Male	Ref	Ref	Ref	Ref
Female	1.15 (1.03-1.29)	0.014	1.08 (0.91-1.28)	0.36
Educational level				
Secondary or below	Ref	Ref	Ref	Ref
Post-secondary	1.15 (1.03-1.29)	0.016	1.25 (1.09-1.42)	0.001
Occupation				
Unemployed/housewife	Ref	Ref	Ref	Ref
Employed	0.98 (0.87-1.11)	0.8	1.16 (0.99-1.36)	0.07
Retired	1.49 (1.01-2.19)	0.047	1.34 (0.87-2.04)	0.18
Student	0.79 (0.64-0.95)	0.015	0.98 (0.77-1.24)	0.85
Monthly income				
< 1450 NIS	Ref	Ref	Ref	Ref
≥ 1450 NIS	1.15 (1.02-1.30)	0.027	1.19 (1.007-1.411)	0.041
Marital status				
Single	Ref	Ref	Ref	Ref
Married	1.25 (1.11-1.41)	<0.001	1.01 (0.87-1.17)	0.92
Divorced/Widowed	1.30 (0.95-1.80)	0.12	1.05 (0.74-1.49)	0.80
Residency				
Gaza Strip	Ref	Ref	Ref	Ref
WBJ	1.07 (0.95-1.20)	0.27	0.95 (0.81-1.11)	0.53
Having a chronic disease				
No	Ref	Ref	Ref	Ref
Yes	1.32 (1.16-1.52)	<0.001	1.15 (0.98-1.35)	0.09
Knowing someone with cancer				
No	Ref	Ref	Ref	Ref
Yes	1.52 (1.35-1.70)	<0.001	1.61 (1.43-1.81)	<0.001
Ever smoked cigarettes and/or shisha				
No	Ref	Ref	Ref	Ref
Yes	0.88 (0.78-1.00)	0.043	0.88 (0.75-1.03)	0.12
Site of data collection				
Public Spaces	Ref	Ref	Ref	Ref
Hospitals	1.37 (1.20-1.56)	<0.001	1.46 (1.27-1.68)	<0.001
Primary healthcare centers	1.79 (1.55-2.07)	<0.001	2.04 (1.73-2.40)	<0.001

COR= crude odds ratio, AOR= adjusted odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

*Adjusted for age-group, gender, educational level, occupation, monthly income, marital status, residency, having a chronic disease, knowing someone with cancer, smoking history, and site of data collection.

12

1 *Association between recognizing smoking-related risk factors and participant characteristics*

2 Participants with higher education level (above secondary) were more likely than other

3 participants to recognize all smoking-related risk factors (table 5). In addition, participants

4 recruited from hospitals or PHCs were more likely than participants recruited from public spaces

5 to recognize two out of the three smoking-related risk factors. In contrast, participants who ever

6 smoked cigarettes and/or shisha were less likely than participants who never smoked to

7 recognize all smoking-related risk factors.

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Table 5: Multivariable logistic regression analyzing factors associated with the recognition of smoking-related risk factors.

Characteristic	Smoking cigarettes		Smoking shisha		Exposure to another person's cigarette smoke	
	AOR (95% CI)*	p	AOR (95% CI)*	p	AOR (95% CI)*	p
Age group						
18 to 44	Ref	Ref	Ref	Ref	Ref	Ref
45 or older	0.84 (0.61-1.17)	0.30	1.24 (0.93-1.66)	0.14	1.04 (0.84-1.28)	0.72
Gender						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	0.98 (0.69-1.39)	0.90	0.60 (0.44-0.82)	0.001	1.03 (0.83-1.27)	0.82
Educational level						
Secondary or below	Ref	Ref	Ref	Ref	Ref	Ref
Post-secondary	1.74 (1.33-2.28)	<0.001	1.74 (1.38-2.18)	<0.001	1.29 (1.09-1.51)	0.002
Occupation						
Unemployed/housewife	Ref	Ref	Ref	Ref	Ref	Ref
Employed	1.12 (0.81-1.55)	0.50	1.04 (0.78-1.37)	0.81	1.06 (0.87-1.30)	0.55
Retired	1.77 (0.68-4.63)	0.25	1.39 (0.58-3.33)	0.46	1.20 (0.96-2.09)	0.51
Student	1.02 (0.62-1.68)	0.94	1.01 (0.66-1.54)	0.98	0.81 (0.61-1.09)	0.16
Monthly income						
≤ 1450 NIS	Ref	Ref	Ref	Ref	Ref	Ref
≥ 1450 NIS	0.91 (0.65-1.29)	0.61	099 (0.74-131)	0.93	0.85 (0.69-1.05)	0.14
Marital status						
Single	Ref	Ref	Ref	Ref	Ref	Ref
Married	1.20 (0.88-1.64)	0.25	1.09 (0.84-1.42)	0.53	1.12 (0.92-1.35)	0.25
Divorced/Widowed	0.66 (0.36-1.20)	0.17	0.71 (0.42-1.22)	0.23	0.93 (0.60-1.44)	0.74
Residency						
Gaza Strip	Ref	Ref	Ref	Ref	Ref	Ref
WBJ	1.26 (0.91-1.74)	0.15	1.33 (1.02-1.75)	0.038	1.29 (1.06-1.56)	0.011
Having a chronic disease						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.87 (0.63-1.20)	0.39	0.88 (0.67-1.16)	0.37	1.02 (0.83-1.35)	0.87
Knowing someone with cancer						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.17 (0.92-1.49)	0.21	1.06 (0.86-1.30)	0.60	1.17 (1.01-1.36)	0.037
Ever smoked cigarettes and/or shisha						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.54 (0.40-0.75)	<0.001	0.55 (0.42-0.74)	<0.001	0.71 (0.59-0.86)	0.001
Site of data collection						
Public Spaces	Ref	Ref	Ref	Ref	Ref	Ref
Hospitals	1.52 (1.14-2.01)	0.004	1.30 (1.01-1.66)	0.041	1.11 (0.94-1.32)	0.22
Primary healthcare centers	1.47 (1.05-2.05)	0.024	1.07 (0.81-1.39)	0.64	1.29 (1.05-1.58)	0.017

AOR= adjusted odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

*Adjusted for age-group, gender, educational level, occupation, monthly income, marital status, residency, having a chronic disease, knowing someone with cancer, smoking history, and site of data collection.

14

1   *Association between recognizing other LC risk factors and participant characteristics*

2   Participants who knew someone with cancer were more likely than those who did not to

3   recognize 'exposure to chemicals', 'exposure to radiation', 'air pollution', 'having a previous

4   history of cancer', and 'having had treatment for any cancer in the past' as LC risk factors (table

5   6). In addition, participants recruited from hospitals or PHCs were more likely than participants

6   recruited from public spaces to recognize 'exposure to chemicals', 'air pollution', 'having a

7   previous history of lung disease', 'having a previous history of cancer', and 'having had

8   treatment for any cancer in the past'.

15

Table 6: Multivariable logistic regression analyzing factors associated with the recognition of other risk factors.

Characteristic	Exposure to chemicals		Exposure to radiation		Air pollution	
	AOR (95% CI)*	p	AOR (95% CI)*	p	AOR (95% CI)*	p
Age group						
18 to 44	Ref	Ref	Ref	Ref	Ref	Ref
45 or older	1.17 (0.95-1.44)	0.13	1.38 (1.11-1.70)	0.003	1.13 (0.92-1.40)	0.25
Gender						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	0.91 (0.74-1.11)	0.35	0.95 (0.77-1.17)	0.60	0.98 (0.80-1.21)	0.88
Educational level						
Secondary or below	Ref	Ref	Ref	Ref	Ref	Ref
Post-secondary	1.26 (1.08-1.48)	0.004	1.47 (1.26-1.73)	<0.001	1.16 (0.98-1.36)	0.08
Occupation						
Unemployed/housewife	Ref	Ref	Ref	Ref	Ref	Ref
Employed	0.85 (0.70-1.04)	0.12	1.20 (0.99-1.46)	0.06	1.03 (0.84-1.26)	0.77
Retired	0.88 (0.51-1.52)	0.65	2.64 (1.24-5.60)	0.011	1.11 (0.63-1.95)	0.72
Student	0.68 (0.65-1.16)	0.33	1.29 (0.97-1.73)	0.08	0.83 (0.62-1.11)	0.21
Monthly income						
< 1450 NIS	Ref	Ref	Ref	Ref	Ref	Ref
≥ 1450 NIS	1.18 (0.96-1.46)	0.11	1.30 (1.06-1.60)	0.013	1.12 (0.91-1.37)	0.29
Marital status						
Single	Ref	Ref	Ref	Ref	Ref	Ref
Married	0.92 (0.77-1.11)	0.41	1.27 (1.06-1.52)	0.011	0.89 (0.73-1.07)	0.21
Divorced/Widowed	0.81 (0.53-1.23)	0.32	1.10 (0.72-1.68)	0.67	0.75 (0.49-1.16)	0.20
Residency						
Gaza Strip	Ref	Ref	Ref	Ref	Ref	Ref
WBJ	1.09 (0.89-1.32)	0.40	0.86 (0.71-1.05)	0.14	1.47 (1.21-1.78)	<0.001
Having a chronic disease						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.04 (0.74-1.28)	0.71	1.02 (0.83-1.25)	0.89	1.11 (0.89-1.37)	0.35
Knowing someone with cancer						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.72 (1.48-1.99)	<0.001	1.52 (1.32-1.76)	<0.001	1.51 (1.31-1.76)	<0.001
Ever smoked cigarettes and/or shisha						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.97 (0.80-1.18)	0.76	0.89 (0.73-1.08)	0.23	1.07 (0.88-1.31)	0.48
Site of data collection						
Public Spaces	Ref	Ref	Ref	Ref	Ref	Ref
Hospitals	1.77 (1.49-2.10)	<0.001	1.05 (0.89-1.25)	0.57	1.41 (119-1.68)	<0.001
Primary healthcare centers	2.38 (1.94-2.94)	<0.001	1.16 (0.95-1.41)	0.15	1.77 (1.44-2.18)	<0.001

AOR=adjusted odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

*Adjusted for age-group, gender, educational level, occupation, monthly income, marital status, residency, having a chronic disease, knowing someone with cancer, smoking history, and site of data collection.

16

Table 6: Multivariable logistic regression analyzing factors associated with the recognition of other risk factors (Ctd).

Characteristic	Having a previous history of lung disease		Having a previous history of cancer		Having had treatment for any cancer in the past		Having a close relative with lung cancer	
	AOR (95% CI)*	p	AOR (95% CI)*	p	AOR (95% CI)*	p	AOR (95% CI)*	p
Age group								
18 to 44	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
45 or older	1.14 (0.96-1.36)	0.13	1.07 (0.90-1.26)	0.44	1.03 (0.88-1.21)	0.72	1.16 (0.98-1.36)	0.08
Gender								
Male	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Female	1.06 (0.89-1.26)	0.51	0.98 (0.83-1.16)	0.83	1.04 (0.88-1.23)	0.63	1.30 (1.10-1.54)	0.002
Educational level								
Secondary or below	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Above secondary	1.11 (0.97-1.27)	0.13	0.94 (0.82-1.07)	0.34	1.10 (0.97-1.25)	0.14	1.12 (0.98-1.27)	0.09
Occupation								
Unemployed/housewife	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Employed	1.26 (1.07-1.49)	0.007	1.04 (0.88-1.22)	0.66	1.01 (0.87-1.19)	0.87	1.21 (1.04-1.42)	0.016
Retired	1.41 (0.89-2.24)	0.14	1.60 (1.02-2.49)	0.039	0.99 (0.65-1.49)	0.95	1.22 (0.81-1.84)	0.35
Student	1.03 (0.80-1.31)	0.84	0.97 (0.76-1.23)	0.79	1.24 (0.98-1.57)	0.07	0.81 (0.64-1.03)	0.08
Monthly income								
<1450 NIS	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
≥1450 NIS	0.91 (0.76-1.09)	0.29	1.08 (0.91-1.27)	0.40	1.00 (0.85-1.18)	1.00	1.02 (0.86-1.21)	0.82
Marital status								
Single	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Married	1.01 (0.86-1.19)	0.89	0.98 (0.84-1.14)	0.76	1.11 (0.74-1.02)	0.18	0.86 (0.74-1.00)	0.047
Divorced/Widowed	0.95 (0.66-1.38)	0.79	1.15 (080-1.64)	0.46	1.01 (0.71-1.44)	0.94	0.86 (0.61-1.22)	0.40
Residency								
Gaza Strip	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
WBJ	0.98 (0.83-1.15)	0.77	1.01 (0.87-1.19)	0.86	0.97 (0.83-1.14)	0.73	1.17 (1.00-1.36)	0.53
Having a chronic disease								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.02 (0.85-1.21)	0.85	1.01 (0.86-1.19)	0.91	0.86 (0.74-1.02)	0.08	1.02 (0.86-1.19)	0.84
Knowing someone with cancer								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.13 (1.00-1.28)	0.06	1.47 (031-1.66)	<0.001	1.30 (1.15-1.46)	<0.001	1.11 (0.98-1.24)	0.10
Ever smoked cigarettes and/or shisha								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.91 (0.77-1.08)	0.28	0.88 (0.75-1.03)	0.12	1.02 (0.87-1.19)	0.84	0.92 (0.78-1.07)	0.28
Site of data collection								
Public Spaces	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Hospitals	1.30 (1.45-1.50)	<0.001	1.40 (1.22-1.61)	<0.001	1.16 (1.01-1.33)	0.038	1.08 (0.94-1.24)	0.29
Primary healthcare centers	1.52 (1.28-1.80)	<0.001	1.86 (1.58-2.19)	<0.001	1.70 (1.45-1.99)	<0.001	1.14 (0.98-1.34)	0.20

AOR= adjusted odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

*Adjusted for age-group, gender, educational level, occupation, monthly income, marital status, residency, having a chronic disease, knowing someone with cancer, smoking history, and site of data collection.

17

1 **Discussion**

2 Half of the study participants demonstrated good awareness of LC risk factors, defined as

3 recognizing more than seven out of the 10 LC risk factors. Participants from the WBJ and the

4 Gaza Strip demonstrated a similar likelihood of having a good awareness level. The factors

5 associated with having good awareness levels of LC risk factors were being ≥ 45 years, higher

6 levels of education and monthly income, knowing someone with cancer, and visiting hospitals

7 and PHCs. Smoking-related risk factors were more often recognized than other risk factors. The

8 most frequently recognized LC risk factor was 'smoking cigarettes' followed by 'smoking

9 shisha'. Interestingly, participants who ever smoked were less likely to recognize smoking-

10 related risk factors than those who never smoked.

11 Awareness of LC risk factors among Palestinians was higher than knowledge of other types of

12 cancer.[18-20] Only 17.4% of Palestinians displayed good knowledge of ovarian cancer

13 symptoms,[20] 23.7% had good knowledge of cervical cancer risk factors[19] and 27.4%

14 demonstrated good knowledge of cervical cancer warning signs.[18]

15

16 The majority of LC cases are diagnosed late, which may be in part due to a lack of awareness

17 about LC risk factors, symptoms, and prognosis.[29] Educational interventions that raise the

18 knowledge about various aspects of LC awareness are critical to develop behaviors that lead to

19 the prevention and early diagnosis of LC.[30] The high mortality rate of LC, especially in low-

20 resource settings like Palestine [31, 32] and the high smoking rates, ranging from 30.0% to 47.7%,[5,

21 33, 34] necessitate finding approaches to increase awareness of LC risk factors. Although there are

18

1   tobacco control policies in Palestine,[35] there is a substantial need to monitor their outreach and

2   implementation more closely. This is especially important given the widespread availability of

3   tobacco products on all premises in public and to all ages. Such monitoring of the

4   implementation of government tobacco control policies was shown to discourage people from

5   smoking, which could reduce both active and passive smoking and, thus, LC morbidity and

6   mortality.[36-38]

7   *Awareness of LC risk factors*

8   Smoking cigarettes was the most recognized LC risk factor in this study followed by smoking

9   shisha and exposure to another person's cigarette smoke (passive smoking), respectively. In a

10   previous study from Oman, smoking cigarettes was the most recognized LC risk factor (79.8%)

11   and passive smoking was the third (55.7%).[9] Similarly, in a previous study from Jordan, the

12   majority believed that active cigarette smoking, shisha smoking, and passive smoking were all

13   linked to cancer.[39]

14   Musmar and colleagues reported that 34.7% of university students in Palestine were current

15   smokers.[34] Students in the arts and humanities were found to have a considerably greater risk of

16   smoking than students in the sciences or in healthcare.[34] The fact that health sciences students

17   were found to be less likely to smoke might be partly due to the influence of smoking-related

18   health education.[34] This is also supported by the findings of this study, where participants who

19   had never smoked were more likely to demonstrate good awareness of smoking-related risk

20   factors than ever smokers, highlighting the potentially empowering influence of health education

21   on smoking behavior.

1 Chapple and colleagues found that LC patients felt unjustly blamed for their disease. LC patients

2 felt particularly stigmatized regardless of their smoking status, because the condition is closely

3 linked to smoking, which negatively impacted their interaction with family, friends, and

4 physicians.[40] Such stigma may drive individuals who have a possible LC symptom accompanied

5 by risk factors to seek medical advice late, and thus, lead to diagnoses at advanced stages. Health

6 practitioners who have contact with current and former smokers must be well trained to offer a

7 safe and non-judgmental environment for people who arrive with symptoms suggestive of LC.[26]

8 Chawla and colleagues showed that having benefitted from post-secondary education was a main

9 factor associated with good awareness of LC risk factors,[41] which comes in concordance with

10 this study. Educational levels in Palestine are good and the illiteracy rate is low at only 2.5% [42],

11 which could contribute to the fair awareness of LC risk factors found in this study, compared

12 with the lower levels in other regional studies.[39, 43] Participants who benefitted from higher

13 education appear to be more concerned about their health and more likely to avoid risky

14 behaviors such as smoking.[44, 45] Future educational interventions aiming to raise awareness of

15 LC risk factors should be tailored to match the level of health literacy among individuals with

16 low education.

17 *Future directions*

18 Public health interventions that aim to promote the recognition of LC risk factors may have a

19 major potential to improve LC outcomes for those most at risk in an attempt to reduce patient-

20 related delays to diagnosis. The creation of widespread public education programs and enriching

21 school curricula with subjects outlining important symptoms and risk factors of LC may also

1 play a role. However, this might need to be complemented by effective implementation of

2 tobacco control regulations to achieve the greatest impact. This is especially important in low-

3 and middle-income countries, such as Palestine, where access to treatment might otherwise be

4 delayed and outcomes are poorer.[46, 47]

5 *Strengths and limitations*

6 The major strengths of this study include the use of a translated version of the validated tool

7 (LCAM) to measure the awareness of LC risk factors, the large sample size, and the high

8 response rate. Furthermore, the wide coverage of the major geographical areas of Palestine and

9 collecting data from different places within each area allowed for direct evaluation of the

10 knowledge of LC risk factors at various levels in the Palestinian population. This study has some

11 limitations though. The use of convenience sampling does not guarantee the generalizability of

12 the findings. However, the large number of participants, the diversity of geographical areas

13 included, and the high response rate may mitigate this. Another limitation could be that visitors

14 or patients in the oncology departments as well as those with medical backgrounds were all

15 ineligible, which might have reduced the number of participants with a presumably good

16 awareness. Nevertheless, this was intended to make the measured awareness more relevant to the

17 overall public awareness.

18 *Conclusion*

19 Awareness of LC risk factors was relatively good with half of the participants displaying good

20 awareness. Smoking-related risk factors were the most recognized risk factors. Older age, higher

21 education, higher monthly income, knowing someone with cancer and visiting healthcare

21

1 facilities were factors associated with good awareness. Formulation and effective

2 implementation of tobacco control policies are essential to change smoking behavior and

3 increase awareness. This should be complemented by educational initiatives to improve public

4 understanding of LC and the perception of smoking danger. Such interventions are especially

5 useful in low-resource settings, such as Palestine, where access to diagnosis and treatment is

6 limited.

7 **Other information**

8 **Data statement:** Data are available upon reasonable request.

9 **Ethical considerations:** Prior to data collection, ethical approval had been obtained from the

10 Human Resources Development Department at the Palestinian Ministry of Health and the

11 Helsinki Committee in the Gaza Strip on the 24th of June, 2017. In addition, another approval

12 was obtained from the Research Ethics Committee at the Islamic University of Gaza on the 26th

13 of June, 2017. The participants had a thorough explanation about the study purposes with the

14 focus that their participation was completely voluntary. Written informed consent was taken

15 from study participants before starting the questionnaire and data were collected anonymously.

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4 NS, YH, OG, WA2, OO, MD, JA, RE, AZ, HH and MA3 contributed to design of the study, data

5 collection, data entry, and data interpretation. NAE and BB contributed to design of the study,

6 data interpretation, drafting of the manuscript, and supervision of the work. All authors have read

7 and approved the final manuscript. Each author has participated sufficiently in the work to take

8 public responsibility for the content.

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Awareness of Lung Cancer Risk Factors in Palestine: Current Situation and Future Directions

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Supplemental table 1: Bivariable logistic regression analyzing factors associated with the recognition of smoking-related risk factors.

Characteristic	Smoking cigarettes		Smoking shisha		Exposure to another person's cigarette smoke	
	COR (95% CI)	p	COR (95% CI)	p	COR (95% CI)	p
Age group						
18 to 44	Ref	Ref	Ref	Ref	Ref	Ref
45 or older	0.76 (0.59-0.98)	0.038	1.09(0.86-1.38)	0.47	1.09 (0.92-1.29)	0.32
Gender						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	1.27 (1.01-1.61)	0.044	0.77 (0.63-0.95)	0.013	1.25 (1.08-1.45)	0.002
Educational level						
Secondary or below	Ref	Ref	Ref	Ref	Ref	Ref
Post-secondary	1.76 (1.38-2.24)	<0.001	1.71 (1.39-2.10)	<0.001	1.18 (1.02-1.36)	0.028
Occupation						
Unemployed/housewife	Ref	Ref	Ref	Ref	Ref	Ref
Employed	0.98(0.76-1.25)	0.84	1.31 (1.06-1.62)	0.013	0.91 (0.78-1.07)	0.26
Retired	1.41 (0.57-3.52)	0.46	2.01 (0.87-4.62)	0.10	1.11 (0.66-1.87)	0.69
Student	1.09 (0.72-1.67)	0.68	1.32 (0.92-1.89)	0.13	0.74 (0.58-0.94)	0.015
Monthly income						
< 1450 NIS	Ref	Ref	Ref	Ref	Ref	Ref
≥ 1450 NIS	1.02 (0.80-1.32)	0.85	1.26 (1.03-1.55)	0.028	0.98 (0.84-1.15)	0.82
Marital status						
Single	Ref	Ref	Ref	Ref	Ref	Ref
Married	1.11 (0.86-1.43)	0.44	0.98 (0.79-1.22)	0.87	1.23 (1.05-1.44)	0.009
Divorced/Widowed	0.53 (0.31-0.89)	0.016	0.58 (0.36-0.94)	0.027	1.06 (0.71-1.58)	0.78
Residency						
Gaza Strip	Ref	Ref	Ref	Ref	Ref	Ref
WBJ	1.04 (0.82-1.31)	0.77	1.20(0.99-1.47)	0.07	1.11 (0.96-1.29)	0.15
Having a chronic disease						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.77 (0.59-1.01)	0.06	0.90 (0.71-1.14)	0.40	1.09 (0.91-1.31)	0.32
Knowing someone with cancer						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.04 (0.82-1.32)	0.74	1.04 (0.85-1.27)	0.72	1.12 (0.97-1.30)	0.12
Ever smoked cigarettes and/or shisha						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.58 (0.46-0.74)	<0.001	0.82 (0.66-1.01)	0.07	0.71 (0.61-0.83)	<0.001
Site of data collection						
Public Spaces	Ref	Ref	Ref	Ref	Ref	Ref
Hospitals	1.40 (1.07-1.84)	0.015	1.27 (1.00-1.61)	0.054	1.11 (0.94-1.31)	0.22
Primary healthcare centers	1.48 (1.09-2.01)	0.012	0.93 (0.73-1.18)	0.53	1.36 (1.12-1.64)	0.002

COR= crude odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

Supplemental table 2: Bivariable logistic regression analyzing factors associated with the recognition of other risk factors.

Characteristic	Exposure to chemicals		Exposure to radiation		Air pollution	
	COR (95% CI)	p	COR (95% CI)	p	COR (95% CI)	p
Age group						
18 to 44	Ref	Ref	Ref	Ref	Ref	Ref
45 or older	1.23 (1.04-1.46)	0.016	1.43 (1.21-1.71)	<0.001	1.27 (1.07-1.51)	0.007
Gender						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	1.07 (0.93-1.23)	0.35	0.90 (0.78-1.04)	0.16	0.97 (0.84-1.12)	0.71
Educational level						
Secondary or below	Ref	Ref	Ref	Ref	Ref	Ref
Post-secondary	1.11 (0.96-1.27)	0.17	1.46 (0.26-1.68)	<0.001	1.05 (0.91-1.21)	0.50
Occupation						
Unemployed/housewife	Ref	Ref	Ref	Ref	Ref	Ref
Employed	0.84 (0.72-0.98)	0.023	1.27 (1.10-1.48)	0.002	1.05 (0.90-1.23)	0.50
Retired	1.10 (0.66-1.82)	0.72	3.82 (1.85-7.92)	<0.001	1.34 (0.79-2.27)	0.28
Student	0.77 (0.61-0.98)	0.032	1.18 (0.93-1.51)	0.18	0.81 (0.64-1.03)	0.09
Monthly income						
< 1450 NIS	Ref	Ref	Ref	Ref	Ref	Ref
≥ 1450 NIS	1.19 (1.02-1.38)	0.023	1.33 (1.14-1.54)	<0.001	1.45 (1.25-1.68)	<0.001
Marital status						
Single	Ref	Ref	Ref	Ref	Ref	Ref
Married	1.16 (0.99-1.35)	0.06	1.24 (1.07-1.44)	0.005	1.10 (0.94-1.28)	0.24
Divorced/Widowed	0.96 (0.65-1.41)	0.83	1.06 (0.72-1.56)	0.77	0.95 (0.64-1.41)	0.79
Residency						
Gaza Strip	Ref	Ref	Ref	Ref	Ref	Ref
WBJ	1.18 (1.02-1.36)	0.025	1.05 (0.91-1.21)	0.50	1.59 (1.37-1.83)	<0.001
Having a chronic disease						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.21 (1.01-1.45)	0.035	1.20 (1.00-1.43)	0.044	1.30 (1.08-1.56)	0.006
Knowing someone with cancer						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.59 (1.38-1.83)	<0.001	1.54 (1.34-1.78)	<0.001	1.49 (1.29-1.72)	<0.001
Ever smoked cigarettes and/or shisha						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.98 (0.84-1.14)	0.81	1.01 (0.87-1.18)	0.87	1.17 (1.00-1.37)	0.054
Site of data collection						
Public Spaces	Ref	Ref	Ref	Ref	Ref	Ref
Hospitals	1.67 (1.42-1.97)	<0.001	1.01 (0.85-1.19)	0.95	1.37 (1.16-1.61)	<0.001
Primary healthcare centers	2.04 (1.69-2.47)	<0.001	0.97 (0.81-1.16)	0.75	1.49 (1.24-1.79)	<0.001

COR= adjusted odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

Supplemental table 3: Bivariable logistic regression analyzing factors associated with the recognition of other risk factors.

Characteristic	Having a previous history of lung disease		Having a previous history of cancer		Having had treatment for any cancer in the past		Having a close relative with lung cancer	
	COR (95% CI)*	p	COR (95% CI)*	p	COR (95% CI)*	p	COR (95% CI)*	p
Age group								
18 to 44	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
45 or older	1.16 (1.00-1.33)	0.043	1.20 (1.05-1.38)	0.007	0.97 (0.85-1.11)	0.65	1.15 (1.01-1.31)	0.032
Gender								
Male	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Female	1.04 (0.92-1.18)	0.50	1.11 (0.99-1.25)	0.08	1.15 (1.02-1.28)	0.019	1.22 (1.09-1.37)	0.001
Educational level								
Secondary or below	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Above secondary	1.07 (0.95-1.20)	0.29	0.89 (0.79-1.00)	0.043	1.08 (0.96-1.21)	0.20	1.10 (0.98-1.24)	0.10
Occupation								
Unemployed/housewife	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Employed	1.08 (0.95-1.23)	0.27	0.88 (0.78-0.99)	0.041	0.90 (0.80-1.02)	0.09	1.04 (0.92-1.18)	0.52
Retired	1.39 (0.90-2.15)	0.13	1.56 (1.03-2.37)	0.036	0.95 (0.65-1.39)	0.79	1.09 (0.75-1.60)	0.65
Student	0.86 (0.70-1.05)	0.15	0.76 (0.62-0.93)	0.007	1.03 (0.85-1.26)	0.76	0.82 (0.67-1.00)	0.05
Monthly income								
<1450 NIS	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
≥1450 NIS	0.91 (0.80-1.03)	0.15	1.02 (0.90-1.15)	0.79	0.96 (0.85-1.08)	0.50	1.15 (1.01-1.30)	0.030
Marital status								
Single	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Married	1.15 (1.01-1.31)	0.033	1.19 (1.05-1.35)	0.006	1.11 (0.98-1.26)	0.09	1.01 (0.89-1.14)	0.88
Divorced/Widowed	1.09 (0.77-1.53)	0.63	1.38 (0.99-1.92)	0.06	0.95 (0.69-1.31)	0.74	1.11 (0.80-1.53)	0.53
Residency								
Gaza Strip	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
WBJ	0.93 (0.82-1.05)	0.27	1.05 (0.93-1.18)	0.43	0.95 (0.85-1.06)	0.36	1.20 (1.07-1.35)	0.002
Having a chronic disease								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.09 (0.94-1.26)	0.26	1.17 (1.02-1.35)	0.027	0.91 (0.79-1.04)	0.18	1.10 (0.95-1.26)	0.20
Knowing someone with cancer								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.08 (0.96-1.22)	0.20	1.38 (1.23-1.55)	<0.001	1.21 (1.08-1.35)	0.001	1.10 (0.98-1.23)	0.12
Ever smoked cigarettes and/or shisha								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.92 (0.81-1.05)	0.21	0.90 (0.79-1.02)	0.10	0.93 (0.82-1.05)	0.23	0.87 (0.76-0.98)	0.026
Site of data collection								
Public Spaces	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Hospitals	1.28 (1.12-1.48)	<0.001	1.37 (1.20-1.56)	<0.001	1.12 (0.98-1.27)	0.10	1.03 (0.91-1.18)	0.61
Primary healthcare centers	1.46 (1.25-1.70)	<0.001	1.73 (1.49-2.01)	<0.001	1.61 (1.39-1.86)	<0.001	1.13 (0.98-1.31)	0.10

COR= crude odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			**4**
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	N/A
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7-8
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(*e*) Describe any sensitivity analyses	N/A
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-9
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12-17
		(*b*) Report category boundaries when continuous variables were categorized	N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	21
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	21
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	22

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Current Situation and Future Directions of Lung Cancer Risk Factor Awareness in Palestine: A Cross-sectional Study

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2
3   **Current Situation and Future Directions of Lung Cancer Risk Factor Awareness in**
4   **Palestine: A Cross-sectional Study**
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1

1   **Word count:** 3793

2   **Abstract**

3   **Objectives:** To evaluate lung cancer (LC) risk factor awareness among Palestinians and identify

4   factors associated with good awareness.

5   **Design:** Cross-sectional study.

6   **Settings:** Participants were recruited using convenience sampling from hospitals, primary

7   healthcare centers, and public spaces located at 11 governorates in Palestine.

8   **Participants:** Of 5174 approached, 4817 participants completed the questionnaire (response

9   rate= 93.1%). A total of 4762 questionnaires were included: 2742 from the West Bank and

10   Jerusalem (WBJ) and 2020 from the Gaza Strip. Exclusion criteria were working or studying in a

11   health-related field, having a nationality other than Palestinian, and visiting oncology

12   departments or clinics at the time of data collection.

13   **Tool:** A modified version of the validated LC Awareness Measure was used for data collection.

14   **Primary and secondary outcomes:** The primary outcome was LC risk factor awareness level as

15   determined by the number of factors recognized: poor(0-3), fair(4-7), and good(8-10). Secondary

16   outcomes include the recognition of each LC risk factor.

17   **Results:** Smoking-related risk factors were more often recognized than other LC risk factors.

18   The most recognized risk factors were 'smoking cigarettes'(n=4466, 93.8%) and 'smoking

19   shisha [waterpipes]'(n=4337, 91.1%). The least recognized risk factors were 'having a close

2

1 relative with LC'(n=2084, 43.8%) and 'having had treatment for any cancer in the past'(n=2368,

2 49.7%).

3 A total of 2381 participants (50.0%) displayed good awareness of LC risk factors. Participants

4 from the WBJ and the Gaza Strip had similar likelihood to display good awareness (50.6% vs.

5 49.1%). Being ≥45 years, having higher education and monthly income, knowing someone with

6 cancer, and visiting hospitals and primary healthcare centers were all associated with an increase

7 in the likelihood of displaying good awareness.

8 **Conclusion:** Half of study participants displayed good awareness of LC risk factors. Educational

9 interventions are warranted to further improve public awareness of LC risk factors, especially

10 those unrelated to smoking.

11 **Keywords:** lung cancer, risk factors, behavioral changes, prevention, early detection, early

12 diagnosis, health education, awareness, Palestine.

13 **Strengths and limitations of this study**

14 • The large sample size was a major strength of this study.

15 • The wide coverage of the major geographical areas of Palestine and collecting data from

16 different places within each area allowed for direct evaluation of the knowledge of LC

17 risk factors at various levels in the Palestinian population.

18 • The use of convenience sampling does not guarantee the generalizability of the findings.

3

- Visitors or patients in the oncology departments as well as those with medical backgrounds were all ineligible, which might have reduced the number of participants with a presumably good awareness.

- Grouping unemployed women and housewives in the same category might be inappropriate, as this may include women with a whole range of socioeconomic and educational background from highly-educated women who chose to focus on family care to those with minimal skills who cannot find work and look after their family as the default option.

Introduction

Lung cancer (LC) is the leading cause of cancer-related deaths worldwide with 18.0% of cancer-related deaths and over 2.2 million newly diagnosed cases in 2020.[1] In the Middle East and North Africa, the estimated number of newly diagnosed LC cases was 79,887 in 2018 with a 5-year relative survival rate of 8.0%.[2] In Palestine, LC is the second most common cancer, accounting for 11.4% of all cancers with an incidence rate of 11.5 per 100,000 general population, and the leading cause of cancer-related mortality accounting for 17.3%.[3]

The most significant risk factor for LC is smoking tobacco products including cigarettes and shisha (waterpipes).[4] Tobacco smoking was reported to be prevalent among 47.7% of Palestinians in the West Bank. Men were found to smoke more than women and to begin smoking at an earlier age, where 74.4% of smokers started when they were 18 years old or younger. Cigarettes and shisha were found to be the most popular methods of smoking among Palestinian men and women.[5]

4

1 Besides smoking, there are LC risk factors for LC, such as exposure to radiation, occupational

2 hazards like asbestos, air pollution and family history of LC.[6-8] However, previous studies

3 showed that awareness of smoking-related risk factors of LC was higher than that of other LC

4 risk factors.[9-11]

5 One of the most important contributors to the low survival rates of LC is delayed presentation.

6 This could be due to factors related to patients, healthcare providers, the healthcare system, or

7 the disease itself.[12] Awareness of LC risk factors is one of the patient-related factors.

8 Recognition of LC risk factors can help stimulating the development of an active personal risk

9 assessment, which in turn increases the ability to detect and react to related symptoms.[13]

10 Previous studies demonstrated that raising the public awareness of LC increased the number of

11 individuals diagnosed at early stages.[14-16] An early diagnosis of LC contributes to better

12 prognosis.[17] Given the limited resources in Palestine, such educational interventions could be

13 an efficient strategy to mitigate the mortality associated with LC.

14 Therefore, this national study aimed to (i) evaluate the awareness level of LC risk factors among

15 Palestinians, (ii) examine if there is a difference in the awareness level of LC risk factors

16 between the two main areas of Palestine: the West Bank and Jerusalem (WBJ) and the Gaza

17 Strip, and (iii) identify the factors associated with good awareness.

1 **Methods**

2 *Study design and population*

3 This was a national cross-sectional study conducted from July 2019 to March 2020. Palestinian

4 adults (≥ 18 years) were the target population. Participants were recruited from governmental

5 hospitals, primary healthcare centers (PHCs) and public spaces, such as malls, markets,

6 restaurants, mosques, churches, parks, downtowns, transportation stations and others. Exclusion

7 criteria were working or studying in a health-related field, having a nationality other than

8 Palestinian, and visiting oncology departments or clinics at the time of data collection.

9 *Sampling methods*

10 Eligible participants were recruited to the study using a convenience sampling technique from

11 governmental hospitals, PHCs, and public spaces located in 11 governorates (out of 16) across

12 Palestine between July 2019 and March 2020. This was intended to create a diverse study cohort

13 resembling the Palestinian community.[18-20] In 2019, the estimated Palestinian population

14 (≥15 years) was 3,109,063. With a confidence level of 95.0%, a type I error rate of 5.0%, and an

15 absolute error of 2.0%, the minimum required sample size was 2401 participants.

16 *Questionnaire and data collection*

17 A modified version of the LC Awareness Measure (LCAM) was used for data collection. The

18 LCAM is a validated tool that was designed to evaluate the public awareness of LC.[13] The

19 original LCAM was first translated into Arabic by two bilingual healthcare professionals and

20 then back-translated into English by another two different bilingual healthcare professionals. The

6

1 Arabic version of the LCAM was then assessed for content validity and accuracy of translation

2 by three experts in the field of thoracic oncology, public health, and survey design. This was

3 followed by a pilot study (n= 68) to assess the clarity of questions in the Arabic version of the

4 LCAM. The questionnaires of the pilot study were not included in the final analysis. The

5 Cronbach's Alpha was used to assess the internal consistency of the Arabic LCAM and it

6 reached an acceptable value of 0.784.

7 The Arabic LCAM included two sections. The first section described the sociodemographic

8 factors of study participants. The second section evaluated the awareness of 10 LC risk factors

9 using a 5-point Likert scale (1=strongly disagree, 5=strongly agree). Of the 10 risk factors, nine

10 were mentioned in the original LCAM.[13] 'Smoking shisha' was added to the questionnaire as

11 it was deemed important to assess the awareness of this risk factor in the Palestinian community

12 due to its high prevalence.[5]

13 The electronic tool 'Kobo Toolbox' was utilized in the data collection.[21] This safe tool can be

14 used both offline and online on mobile devices. Data collectors completed the questionnaire in a

15 face-to-face interview with the participant using Kobo Toolbox. The data collectors had medical

16 background and received special training on the use of Kobo Toolbox, recruitment of potential

17 study participants, gaining informed consent, and facilitation of completion of the questionnaires.

18 *Statistical analysis*

19 The percentage of new LC cases increases substantially starting from the age of 45.[22] Therefore,

20 participants' age was categorized into two categories using this cutoff: 18-44 years and ≥45 years.

7

1 The monthly income was also categorized into two categories (<1450 NIS and ≥1450 NIS) since

2 1450 NIS (about $450) is the minimum wage in Palestine.[23]

3 The median and interquartile range (IQR) were used to describe continuous, non-normally

4 distributed variables and the Kruskal-Wallis test was used for baseline comparisons. Frequencies

5 and percentages were used to describe categorical variables and Pearson's Chi-square test was used

6 for baseline comparisons.

7 The recognition of each LC risk factor was assessed using a question based on a 5-point Likert

8 scale with 'strongly agree' or 'agree' as a correct answer, and 'strongly disagree', 'disagree', or

9 'not sure' as an incorrect answer. For each correctly recognized LC risk factor, one point was

10 given. LC risk factors were further categorized into two categories: (i) smoking-related and (ii)

11 other risk factors. Recognition of LC risk factors was described using frequencies and percentages

12 with comparisons performed by Pearson's Chi-Square test. This was followed by running

13 bivariable and multivariable logistic regression analyses to examine the association between

14 recognizing each LC risk factor and participant characteristics. The multivariable analysis adjusted

15 for age group, gender, educational level, monthly income, occupation, place of residency, marital

16 status, having a chronic disease, knowing someone with cancer, smoking history, and site of data

17 collection. This model was determined a priori based on previous studies.[13, 24-27] The results

18 of the bivariable analyses are presented in supplementary tables 1 to 3, please see additional file

19 1.

20 A scoring system was used to evaluate the participants' awareness level of LC risk factors. Similar

21 scoring systems were also used in previous studies.[18, 27-28] For each correctly recognized LC

22 risk factor, one point was given. The total score (ranging from 0 to 10) was calculated and

8

1   categorized based on the number of recognized LC risk factors into three categories: poor (0 to 3),

2   fair (4 to 7), and good awareness (8 to 10). The awareness level of LC risk factors exhibited by

3   participants from the Gaza Strip was compared with the awareness level exhibited by participants

4   from the WBJ using Pearson's Chi-Square test. Bivariable and multivariable logistic regression

5   analyses were utilized to test the association between participant characteristics and having a good

6   awareness level.

7   Missing data were hypothesized to be missed completely at random and thus, complete case

8   analysis was utilized to handle them. Data were analyzed using Stata software version 16.0

9   (StataCorp, College Station, Texas, United States).

10   *Patients and public involvement*

11   There was no patient or public involvement in the design, conduct, reporting, or dissemination

12   plans of this study. However, results will be disseminated among the professional communities of

13   Palestine and to policymakers, with the intent to inform future health policy decisions.

14   **Results**

15   *Participant characteristics*

16   Of 5174 approached, 4817 participants completed the questionnaire (response rate= 93.1%). In

17   total, 4762 questionnaires were included in the analysis (24 were ineligible and 31 had missing

18   data): 2742 from the WBJ and 2020 from the Gaza Strip. The median age [IQR] for all

19   participants was 32.0 years [24.0, 44.0] (table 1). Participants living in the WBJ were more likely

20   to be older, have higher monthly income but lower level of education, and suffer more often

21   from chronic diseases than participants living in the Gaza Strip.

9

Table 1: Characteristics of study participants.

Characteristic	Total (n= 4762)	Gaza Strip (n= 2020)	WBJ (n= 2742)	p-value
Age, median [IQR]	32.0 [24.0, 44.0]	30.0 [24.0, 40.0]	34.0 [24.0, 47.0]	<0.001
Age group, n (%)				<0.001
18 to 44	3572 (75.0)	1634 (80.9)	1938 (70.7)	
45 or older	1190 (25.0)	386 (19.1)	804 (29.3)	
Female gender, n (%)	2618 (55.0)	1086 (53.8)	1532 (55.9)	0.15
Educational level, n (%)				
Secondary or below	2375 (49.9)	955 (47.3)	1420 (51.8)	0.002
Post-secondary	2387 (50.1)	1065 (52.7)	1322 (48.2)	
Occupation, n (%)				
Unemployed/housewife	2003 (42.1)	970 (48.0)	1033 (37.7)	<0.001
Employed	2160 (45.4)	814 (40.3)	1346 (49.1)	
Retired	111 (2.3)	46 (2.3)	65 (2.4)	
Student	488 (10.2)	190 (9.4)	298 (10.8)	
Monthly income ≥ 1450 NIS, n (%)	3241 (68.1)	683 (33.8)	2558 (93.3)	<0.001
Marital status, n (%)				
Single	1480 (31.1)	641 (31.7)	839 (30.6)	0.07
Married	3117 (65.5)	1323 (65.5)	1794 (65.4)	
Divorced/Widowed	165 (3.5)	56 (2.8)	109 (4.0)	
Having a chronic disease, n (%)	1032 (21.7)	313 (15.5)	719 (26.2)	<0.001
Knowing someone with cancer, n (%)	2571 (54.0)	1045 (51.7)	1526 (55.7)	0.007
Ever smoked, n (%)				
Cigarettes	1127 (23.7)	417 (20.6)	710 (25.9)	<0.001
Shisha (waterpipes)	499 (10.5)	142 (7.0)	357 (13.0)	<0.001
Site of data collection, n (%)				
Public Spaces	1920 (40.3)	784 (38.8)	1136 (41.4)	<0.001
Hospitals	1628 (34.2)	651 (32.2)	977 (35.7)	
Primary healthcare centers	1214 (25.5)	585 (29.0)	629 (22.9)	

n= number of participants, IQR= interquartile range, WBJ= West Bank and Jerusalem.

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1 *Recognition of LC risk factors*

2 Smoking-related risk factors were more often recognized than other LC risk factors. The most

3 frequently identified risk factors were 'smoking cigarettes' (n= 4466, 93.8%) and 'smoking

4 shisha' (n= 4337, 91.1%) (table 2). These risk factors were the most identified in both the WBJ

5 and the Gaza Strip. The least recognized risk factors were 'having a close relative with LC' (n=

6 2084, 43.8%) and 'having had treatment for any cancer in the past' (n= 2368, 49.7%). These risk

7 factors were also the least identified in both the WBJ and the Gaza Strip.

Table 2: Recognition of lung cancer risk factors.

Factor	Total (n= 4762) n (%)	Gaza Strip (n= 2020) n (%)	WBJ (n= 2742) n (%)	p-value
Smoking-related risk factors				
Smoking cigarettes	4466 (93.8)	1892 (93.7)	2574 (93.9)	0.77
Smoking shisha	4337 (91.1)	1822 (90.2)	2515 (91.7)	0.07
Exposure to another person's cigarette smoke	3867 (81.2)	1621 (80.2)	2246 (81.9)	0.15
Other risk factors				
Air pollution	3838 (80.6)	1543 (76.4)	2295 (83.7)	<0.001
Exposure to chemicals (e.g., asbestos)	3802 (79.8)	1582 (78.3)	2220 (81.0)	0.024
Exposure to radiation	3788 (79.6)	1598 (79.1)	2190 (79.9)	0.52
Having a previous history of lung disease (e.g., COPD)	3216 (67.5)	1382 (68.4)	1834 (66.9)	0.27
Having a previous history of cancer such as head and neck cancer	2778 (58.3)	1165 (57.7)	1613 (58.8)	0.43
Having had treatment for any cancer in the past	2368 (49.7)	1020 (50.5)	1348 (49.2)	0.36
Having a close relative with lung cancer	2084 (43.8)	832 (41.2)	1252 (45.7)	0.002

n= number of participants. WBJ= West Bank and Jerusalem, COPD= chronic obstructive pulmonary disease.

11

1   *Good awareness and its associated factors*

2   A total of 2381 participants (50.0%) displayed good awareness (prompt recognition of more than

3   seven out of 10 LC risk factors) (table 3). Participants from the WBJ and the Gaza Strip had a

4   similar likelihood to display good awareness (50.6% vs. 49.1%). On the multivariable analysis,

5   being ≥ 45 years, having higher education and monthly income, knowing someone with cancer,

6   and visiting hospitals and PHCs were all associated with an increase in the likelihood of having a

7   good awareness level of LC risk factors (table 4).

Table 3: Awareness level of lung cancer risk factors among study participants.

Level	Total n (%)	Gaza Strip n (%)	WBJ n (%)	p-value
Poor (0-3 risk factors)	203 (4.3)	111 (5.5)	92 (3.4)	
Fair (4-7 risk factors)	2178 (45.7)	918 (45.4)	1260 (46.0)	0.001
Good (8-10 risk factors)	2381 (50.0)	991 (49.1)	1390 (50.6)	

n= number of participants, WBJ= West Bank and Jerusalem.

12

Table 4: Bivariable and multivariable logistic regression analyzing factors associated with having a good awareness of lung cancer risk factors.

Characteristic	Good awareness	
	COR (`95% CI)	AOR (95% CI)*
Age group		
18 to 44	Ref	Ref
45 or older	1.33 (1.17- 1.52)	1.20 (1.02- 1.42)
Gender		
Male	Ref	Ref
Female	1.15 (1.03-1.29)	1.08 (0.91-1.28)
Educational level		
Secondary or below	Ref	Ref
Post-secondary	1.15 (1.03-1.29)	1.25 (1.09-1.42)
Occupation		
Unemployed/housewife	Ref	Ref
Employed	0.98 (0.87-1.11)	1.16 (0.99-1.36)
Retired	1.49 (1.01-2.19)	1.34 (0.87-2.04)
Student	0.79 (0.64-0.95)	0.98 (0.77-1.24)
Monthly income		
< 1450 NIS	Ref	Ref
≥ 1450 NIS	1.15 (1.02-1.30)	1.19 (1.07-1.411)
Marital status		
Single	Ref	Ref
Married	1.25 (1.11-1.41)	1.01 (0.87-1.17)
Divorced/Widowed	1.30 (0.95-1.80)	1.05 (0.74-1.49)
Residency		
Gaza Strip	Ref	Ref
WBJ	1.07 (0.95-1.20)	0.95 (0.81-1.11)
Having a chronic disease		
No	Ref	Ref
Yes	1.32 (1.16-1.52)	1.15 (0.98-1.35)
Knowing someone with cancer		
No	Ref	Ref
Yes	1.52 (1.35-1.70)	1.61 (1.43-1.81)
Ever smoked cigarettes and/or shisha		
No	Ref	Ref
Yes	0.88 (0.78-1.00)	0.88 (0.75-1.03)
Site of data collection		
Public Spaces	Ref	Ref
Hospitals	1.37 (1.20-1.56)	1.46 (1.27-1.68)
Primary healthcare centers	1.79 (1.55-2.07)	2.04 (1.73-2.40)

COR= crude odds ratio, AOR= adjusted odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.
*Adjusted for age-group, gender, educational level, occupation, monthly income, marital status, residency, having a chronic disease, knowing someone with cancer, smoking history, and site of data collection.

13

1   *Association between recognizing smoking-related risk factors and participant characteristics*

2   Participants with higher education level (above secondary) were more likely than other

3   participants to recognize all smoking-related risk factors (table 5). In addition, participants

4   recruited from hospitals or PHCs were more likely than participants recruited from public spaces

5   to recognize 'smoking shisha' and 'exposure to another person's cigarette smoke' as smoking-

6   related risk factors. Similarly, participants from the WBJ were more likely than participants from

7   the Gaza Strip to recognize 'smoking shisha' and 'exposure to another person's cigarette smoke'.

8   In contrast, participants who ever smoked cigarettes and/or shisha were less likely than

9   participants who never smoked to recognize all smoking-related risk factors.

14

Table 5: Multivariable logistic regression analyzing factors associated with the recognition of smoking-related risk factors.

Characteristic	Smoking cigarettes	Smoking shisha	Exposure to another person's cigarette smoke
	AOR (95% CI)*	AOR (95% CI)*	AOR (95% CI)*
Age group			
18 to 44	Ref	Ref	Ref
45 or older	0.84 (0.61-1.17)	1.24 (0.93-1.66)	1.04 (0.84-1.28)
Gender			
Male	Ref	Ref	Ref
Female	0.98 (0.69-1.39)	0.60 (0.44-0.82)	1.03 (0.83-1.27)
Educational level			
Secondary or below	Ref	Ref	Ref
Post-secondary	1.74 (1.33-2.28)	1.74 (1.38-2.18)	1.29 (1.09-1.51)
Occupation			
Unemployed/housewife	Ref	Ref	Ref
Employed	1.12 (0.81-1.55)	1.04 (0.78-1.37)	1.06 (0.87-1.30)
Retired	1.77 (0.68-4.63)	1.39 (0.58-3.33)	1.20 (0.96-2.09)
Student	1.02 (0.62-1.68)	1.01 (0.66-1.54)	0.81 (0.61-1.09)
Monthly income			
< 1450 NIS	Ref	Ref	Ref
≥ 1450 NIS	0.91 (0.65-1.29)	0.99 (0.74-131)	0.85 (0.69-1.05)
Marital status			
Single	Ref	Ref	Ref
Married	1.20 (0.88-1.64)	1.09 (0.84-1.42)	1.12 (0.92-1.35)
Divorced/Widowed	0.66 (0.36-1.20)	0.71 (0.42-1.22)	0.93 (0.60-1.44)
Residency			
Gaza Strip	Ref	Ref	Ref
WBJ	1.26 (0.91-1.74)	1.33 (1.02-1.75)	1.29 (1.06-1.56)
Having a chronic disease			
No	Ref	Ref	Ref
Yes	0.87 (0.63-1.20)	0.88 (0.67-1.16)	1.02 (0.83-1.35)
Knowing someone with cancer			
No	Ref	Ref	Ref
Yes	1.17 (0.92-1.49)	1.06 (0.86-1.30)	1.17 (1.01-1.36)
Ever smoked cigarettes and/or shisha			
No	Ref	Ref	Ref
Yes	0.54 (0.40-0.75)	0.55 (0.42-0.74)	0.71 (0.59-0.86)
Site of data collection			
Public Spaces	Ref	Ref	Ref
Hospitals	1.52 (1.14-2.01)	1.30 (1.01-1.66)	1.11 (0.94-1.32)
Primary healthcare centers	1.47 (1.05-2.05)	1.07 (0.81-1.39)	1.29 (1.05-1.58)

AOR= adjusted odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

*Adjusted for age-group, gender, educational level, occupation, monthly income, marital status, residency, having a chronic disease, knowing someone with cancer, smoking history, and site of data collection.

15

1 *Association between recognizing other LC risk factors and participant characteristics*

2 Participants who knew someone with cancer were more likely than those who did not to

3 recognize 'exposure to chemicals', 'exposure to radiation', 'air pollution', 'having a previous

4 history of cancer', and 'having had treatment for any cancer in the past' as LC risk factors (table

5 6). In addition, participants recruited from hospitals or PHCs were more likely than participants

6 recruited from public spaces to recognize 'exposure to chemicals', 'air pollution', 'having a

7 previous history of lung disease', 'having a previous history of cancer', and 'having had

8 treatment for any cancer in the past'. Participants from the WBJ were more likely than those

9 from the Gaza Strip to recognize 'air pollution' and 'having a close relative with cancer'.

16

Table 6: Multivariable logistic regression analyzing factors associated with the recognition of other risk factors.

Characteristic	Exposure to chemicals	Exposure to radiation	Air pollution
	AOR (95% CI)*	AOR (95% CI)*	AOR (95% CI)*
Age group			
18 to 44	Ref	Ref	Ref
45 or older	1.17 (0.95-1.44)	1.38 (1.11-1.70)	1.13 (0.92-1.40)
Gender			
Male	Ref	Ref	Ref
Female	0.91 (0.74-1.11)	0.95 (0.77-1.17)	0.98 (0.80-1.21)
Educational level			
Secondary or below	Ref	Ref	Ref
Post-secondary	1.26 (1.08-1.48)	1.47 (1.26-1.73)	1.16 (0.98-1.36)
Occupation			
Unemployed/housewife	Ref	Ref	Ref
Employed	0.85 (0.70-1.04)	1.20 (0.99-1.46)	1.03 (0.84-1.26)
Retired	0.88 (0.51-1.52)	2.64 (1.24-5.60)	1.11 (0.63-1.95)
Student	0.68 (0.65-1.16)	1.29 (0.97-1.73)	0.83 (0.62-1.11)
Monthly income			
< 1450 NIS	Ref	Ref	Ref
≥ 1450 NIS	1.18 (0.96-1.46)	1.30 (1.06-1.60)	1.12 (0.91-1.37)
Marital status			
Single	Ref	Ref	Ref
Married	0.92 (0.77-1.11)	1.27 (1.06-1.52)	0.89 (0.73-1.07)
Divorced/Widowed	0.81 (0.53-1.23)	1.10 (0.72-1.68)	0.75 (0.49-1.16)
Residency			
Gaza Strip	Ref	Ref	Ref
WBJ	1.09 (0.89-1.32)	0.86 (0.71-1.05)	1.47 (1.21-1.78)
Having a chronic disease			
No	Ref	Ref	Ref
Yes	1.04 (0.74-1.28)	1.02 (0.83-1.25)	1.11 (0.89-1.37)
Knowing someone with cancer			
No	Ref	Ref	Ref
Yes	1.72 (1.48-1.99)	1.52 (1.32-1.76)	1.51 (1.31-1.76)
Ever smoked cigarettes and/or shisha			
No	Ref	Ref	Ref
Yes	0.97 (0.80-1.18)	0.89 (0.73-1.08)	1.07 (0.88-1.31)
Site of data collection			
Public Spaces	Ref	Ref	Ref
Hospitals	1.77 (1.49-2.10)	1.05 (0.89-1.25)	1.41 (1.19-1.68)
Primary healthcare centers	2.38 (1.94-2.94)	1.16 (0.95-1.41)	1.77 (1.44-2.18)

AOR= adjusted odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

*Adjusted for age-group, gender, educational level, occupation, monthly income, marital status, residency, having a chronic disease, knowing someone with cancer, smoking history, and site of data collection.

17

Table 6: Multivariable logistic regression analyzing factors associated with the recognition of other risk factors (Ctd).

Characteristic	Having a previous history of lung disease	Having a previous history of cancer	Having had treatment for any cancer in the past	Having a close relative with lung cancer
	AOR (95% CI)*	AOR (95% CI)*	AOR (95% CI)*	AOR (95% CI)*
Age group				
18 to 44	Ref	Ref	Ref	Ref
45 or older	1.14 (0.96-1.36)	1.07 (0.90-1.26)	1.03 (0.88-1.21)	1.16 (0.98-1.36)
Gender				
Male	Ref	Ref	Ref	Ref
Female	1.06 (0.89-1.26)	0.98 (0.83-1.16)	1.04 (0.88-1.23)	1.30 (1.10-1.54)
Educational level				
Secondary or below	Ref	Ref	Ref	Ref
Above secondary	1.11 (0.97-1.27)	0.94 (0.82-1.07)	1.10 (0.97-1.25)	1.12 (0.98-1.27)
Occupation				
Unemployed/housewife	Ref	Ref	Ref	Ref
Employed	1.26 (1.07-1.49)	1.04 (0.88-1.22)	1.01 (0.87-1.19)	1.21 (1.04-1.42)
Retired	1.41 (0.89-2.24)	1.60 (1.02-2.49)	0.99 (0.65-1.49)	1.22 (0.81-1.84)
Student	1.03 (0.80-1.31)	0.97 (0.76-1.23)	1.24 (0.98-1.57)	0.81 (0.64-1.03)
Monthly income				
< 1450 NIS	Ref	Ref	Ref	Ref
≥ 1450 NIS	0.91 (0.76-1.09)	1.08 (0.91-1.27)	1.00 (0.85-1.18)	1.02 (0.86-1.21)
Marital status				
Single	Ref	Ref	Ref	Ref
Married	1.01 (0.86-1.19)	0.98 (0.84-1.14)	1.11 (0.74-1.02)	0.86 (0.74-1.00)
Divorced/Widowed	0.95 (0.66-1.38)	1.15 (0.80-1.64)	1.01 (0.71-1.44)	0.86 (0.61-1.22)
Residency				
Gaza Strip	Ref	Ref	Ref	Ref
WBJ	0.98 (0.83-1.15)	1.01 (0.87-1.19)	0.97 (0.83-1.14)	1.17 (1.00-1.36)
Having a chronic disease				
No	Ref	Ref	Ref	Ref
Yes	1.02 (0.85-1.21)	1.01 (0.86-1.19)	0.86 (0.74-1.02)	1.02 (0.86-1.19)
Knowing someone with cancer				
No	Ref	Ref	Ref	Ref
Yes	1.13 (1.00-1.28)	1.47 (0.31-1.66)	1.30 (1.15-1.46)	1.11 (0.98-1.24)
Ever smoked cigarettes and/or shisha				
No	Ref	Ref	Ref	Ref
Yes	0.91 (0.77-1.08)	0.88 (0.75-1.03)	1.02 (0.87-1.19)	0.92 (0.78-1.07)
Site of data collection				
Public Spaces	Ref	Ref	Ref	Ref
Hospitals	1.30 (1.45-1.50)	1.40 (1.22-1.61)	1.16 (1.01-1.33)	1.08 (0.94-1.24)
Primary healthcare centers	1.52 (1.28-1.80)	1.86 (1.58-2.19)	1.70 (1.45-1.99)	1.14 (0.98-1.34)

AOR= adjusted odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

*Adjusted for age-group, gender, educational level, occupation, monthly income, marital status, residency, having a chronic disease, knowing someone with cancer, smoking history, and site of data collection.

18

1 **Discussion**

2 Half of the study participants demonstrated good awareness of LC risk factors, defined as

3 recognizing more than seven out of the 10 LC risk factors. Participants from the WBJ and the

4 Gaza Strip demonstrated a similar likelihood of having a good awareness level. The factors

5 associated with having good awareness levels of LC risk factors were being ≥ 45 years, higher

6 levels of education and monthly income, knowing someone with cancer, and visiting hospitals

7 and PHCs. Smoking-related risk factors were more often recognized than other risk factors. The

8 most frequently recognized LC risk factor was 'smoking cigarettes' followed by 'smoking

9 shisha'. Interestingly, participants who ever smoked were less likely to recognize smoking-

10 related risk factors than those who never smoked.

11 Awareness of LC risk factors among Palestinians was higher than knowledge of other types of

12 cancer.[18-20] Only 17.4% of Palestinians displayed good knowledge of ovarian cancer

13 symptoms,[20] 23.7% had good knowledge of cervical cancer risk factors[19] and 27.4%

14 demonstrated good knowledge of cervical cancer warning signs.[18]

15 The majority of LC cases are diagnosed late, which may be in part due to a lack of awareness of

16 LC symptoms, fear of cancer diagnosis, worries about what might be found, and lack of time to

17 visit a doctor.[28-29] Educational interventions that raise the knowledge about various aspects of

18 LC awareness are critical to develop behaviors that lead to the prevention and early diagnosis of

19 LC.[30] The high mortality rate of LC, especially in low-resource settings like Palestine [31] and

20 the high smoking rates, ranging from 30.0% to 47.7%,[5, 32-33] necessitate finding approaches

21 to increase awareness of LC risk factors. Although there are tobacco control policies in

19

1 Palestine,[34] there is a substantial need to monitor their outreach and implementation more

2 closely. This is especially important given the widespread availability of tobacco products on all

3 premises in public and to all ages. Such monitoring of the implementation of government

4 tobacco control policies was shown to discourage people from smoking, which could reduce both

5 active and passive smoking and, thus, LC morbidity and mortality.[35-36] There are several

6 barriers to implementing tobacco control policies in Palestine. The lack of enforcement of these

7 polices is a major barrier. It is common to see someone smoking in a public place or to see a

8 child who is under 18 years going to a store to buy a pack of cigarettes for their own use or for

9 the use of one of their family members. The law also did not specify the penalties for violating

10 these policies, which limits the adherence of the public. In addition, to the best of our knowledge,

11 there are no specialized centers to help smokers quit smoking. Finally, the poor economic

12 circumstances could be a contributing factor for the inability to implement tobacco control

13 policies as their enforcement requires allocation of a special budget for that purpose.

14 *Awareness of LC risk factors*

15 Smoking cigarettes was the most recognized LC risk factor in this study followed by smoking

16 shisha and exposure to another person's cigarette smoke (passive smoking), respectively. In a

17 previous study from Oman, smoking cigarettes was the most recognized LC risk factor (79.8%)

18 and passive smoking was the third (55.7%).[9] Similarly, in a previous study from Jordan, the

19 majority believed that active cigarette smoking, shisha smoking, and passive smoking were all

20 linked to cancer.[37]

21 Musmar and colleagues reported that 34.7% of university students in Palestine were current

22 smokers.[33] Students in the arts and humanities were found to have a considerably greater risk

20

1 of smoking than students in the sciences or in healthcare.[33] The fact that health sciences

2 students were found to be less likely to smoke might be partly due to the influence of smoking-

3 related health education.[33] This is also supported by the findings of this study, where

4 participants who had never smoked were more likely to demonstrate good awareness of

5 smoking-related risk factors than ever smokers, highlighting the potentially empowering

6 influence of health education on smoking behavior.

7 Chapple and colleagues found that LC patients felt unjustly blamed for their disease. LC patients

8 felt particularly stigmatized regardless of their smoking status, because the condition is closely

9 linked to smoking, which negatively impacted their interaction with family, friends, and

10 physicians.[38] Such stigma may drive individuals who have a possible LC symptom

11 accompanied by risk factors to seek medical advice late, and thus, lead to diagnoses at advanced

12 stages. Health practitioners who have contact with current and former smokers must be well

13 trained to offer a safe and non-judgmental environment for people who arrive with symptoms

14 suggestive of LC.[26]

15 Chawla and colleagues showed that having benefitted from post-secondary education was a main

16 factor associated with good awareness of LC risk factors,[39] which comes in concordance with

17 this study. Educational levels in Palestine are good and the illiteracy rate is low at only 2.5%

18 [40], which could contribute to the fair awareness of LC risk factors found in this study,

19 compared with the lower levels in other regional studies.[37, 41] Participants who benefitted

20 from higher education appear to be more concerned about their health and more likely to avoid

21 risky behaviors such as smoking.[42-43] Future educational interventions aiming to raise

21

1 awareness of LC risk factors should be tailored to match the level of health literacy among

2 individuals with low education.

3 While many similarities existed in the LC awareness of participants in the Gaza Strip compared

4 with those in the WBJ, such as the likelihood to have good awareness of LC risk factors and

5 recognition of smoking cigarettes as a risk factor, there were a few differences. Among these

6 were that participants in the WBJ were more likely to recognize 'passive smoking', 'shisha

7 smoking', 'air pollution', and 'having a close relative with cancer' as risk factors than

8 participants from the Gaza Strip. Residents of the Gaza Strip are not allowed to travel to the WBJ

9 and likewise are residents from the WBJ not allowed to travel to the Gaza Strip. These

10 movement restrictions hinder the exchange of ideas, knowledge and health beliefs among people

11 of both areas. However, the overall greater number of similarities might be encouraging, when

12 considering the delivery of educational interventions to the whole population. The unified school

13 curriculum might be one such way of content delivery and health education and, hence,

14 increasing awareness of LC risk factors among the Palestinian population.

15 *Future directions*

16 Public health interventions that aim to promote the recognition of LC risk factors may have a

17 major potential to improve LC outcomes for those most at risk in an attempt to reduce patient-

18 related delays to diagnosis. The creation of widespread public education programs and enriching

19 school curricula with subjects outlining important symptoms and risk factors of LC may also

20 play a role. However, this might need to be complemented by effective implementation of

21 tobacco control regulations to achieve the greatest impact. This is especially important in low-

22

1   and middle-income countries, such as Palestine, where access to treatment might otherwise be

2   delayed and outcomes are poorer.

3   *Strengths and limitations*

4   The major strengths of this study include the large sample size and the wide geographical

5   coverage of data collection from different places within each main area, which allowed direct

6   evaluation of the knowledge of LC risk factors at various levels in the Palestinian population.

7   This study has some limitations though. The use of convenience sampling does not guarantee the

8   generalizability of the findings. However, the large number of participants, the diversity of

9   geographical areas included, and the high response rate may mitigate this. Another limitation

10   could be that visitors or patients in the oncology departments as well as those with medical

11   backgrounds were all ineligible, which might have reduced the number of participants with a

12   presumably good awareness. Nevertheless, this was intended to make the measured awareness

13   more relevant to the overall public awareness, as people being treated in oncology departments

14   and those visiting such departments were presumed to have better knowledge, compared with the

15   general public without the same contact with healthcare professionals. A further limitation in our

16   questionnaire could be grouping unemployed women and housewives in the same category,

17   while women not in employment may include a whole range of socioeconomic and educational

18   background from those with minimal skills who cannot find work and look after their family as

19   the default option to highly educated women who choose to focus on family care.

20

21

23

1 *Conclusion*

2 Awareness of LC risk factors was relatively good with half of the participants displaying good

3 awareness. Smoking-related risk factors were the most recognized risk factors. Older age, higher

4 education, higher monthly income, knowing someone with cancer and visiting healthcare

5 facilities were factors associated with good awareness. Formulation and effective

6 implementation of tobacco control policies are essential to change smoking behavior and

7 increase awareness. This should be complemented by educational initiatives to improve public

8 understanding of LC and the perception of smoking danger. Such interventions are especially

9 useful in low-resource settings, such as Palestine, where access to diagnosis and treatment is

10 limited.

11 **Other information**

12 **Data statement:** Data are available upon reasonable request.

13 **Ethical considerations:** Prior to data collection, ethical approval had been obtained from the

14 Human Resources Development Department at the Palestinian Ministry of Health and the

15 Helsinki Committee in the Gaza Strip on the 24th of June, 2017. In addition, another approval

16 was obtained from the Research Ethics Committee at the Islamic University of Gaza on the 26th

17 of June, 2017. The participants had a thorough explanation about the study purposes with the

18 focus that their participation was completely voluntary. Written informed consent was taken

19 from study participants before starting the questionnaire and data were collected anonymously.

6 **Author Contributions:** ME and AM contributed to design of the study, data analysis, data

7 interpretation, and drafting of the manuscript. MA1, IA, HA, HS, SQ, FU, MA2, WA1, RN, RK,

8 NS, YH, OG, WA2, OO, MD, JA, RE, AZ, HH and MA3 contributed to design of the study, data

9 collection, data entry, and data interpretation. NAE and BB contributed to design of the study,

10 data interpretation, drafting of the manuscript, and supervision of the work. All authors have read

11 and approved the final manuscript. Each author has participated sufficiently in the work to take

12 public responsibility for the content.

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Current Situation and Future Directions of Lung Cancer Risk Factor Awareness in Palestine: A Cross-sectional Study

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Supplemental table 1: Bivariable logistic regression analyzing factors associated with the recognition of smoking-related risk factors.

Characteristic	Smoking cigarettes	Smoking shisha	Exposure to another person's cigarette smoke
	COR (95% CI)	COR (95% CI)	COR (95% CI)
Age group			
18 to 44	Ref	Ref	Ref
45 or older	0.76 (0.59-0.98)	1.09(0.86-1.38)	1.09 (0.92-1.29)
Gender			
Male	Ref	Ref	Ref
Female	1.27 (1.01-1.61)	0.77 (0.63-0.95)	1.25 (1.08-1.45)
Educational level			
Secondary or below	Ref	Ref	Ref
Post-secondary	1.76 (1.38-2.24)	1.71 (1.39-2.10)	1.18 (1.02-1.36)
Occupation			
Unemployed/housewife	Ref	Ref	Ref
Employed	0.98(0.76-1.25)	1.31 (1.06-1.62)	0.91 (0.78-1.07)
Retired	1.41 (0.57-3.52)	2.01 (0.87-4.62)	1.11 (0.66-1.87)
Student	1.09 (0.72-1.67)	1.32 (0.92-1.89)	0.74 (0.58-0.94)
Monthly income			
< 1450 NIS	Ref	Ref	Ref
≥ 1450 NIS	1.02 (0.80-1.32)	1.26 (1.03-1.55)	0.98 (0.84-1.15)
Marital status			
Single	Ref	Ref	Ref
Married	1.11 (0.86-1.43)	0.98 (0.79-1.22)	1.23 (1.05-1.44)
Divorced/Widowed	0.53 (0.31-0.89)	0.58 (0.36-0.94)	1.06 (0.71-1.58)
Residency			
Gaza Strip	Ref	Ref	Ref
WBJ	1.04 (0.82-1.31)	1.20 (0.99-1.47)	1.11 (0.96-1.29)
Having a chronic disease			
No	Ref	Ref	Ref
Yes	0.77 (0.59-1.01)	0.90 (0.71-1.14)	1.09 (0.91-1.31)
Knowing someone with cancer			
No	Ref	Ref	Ref
Yes	1.04 (0.82-1.32)	1.04 (0.85-1.27)	1.12 (0.97-1.30)
Ever smoked cigarettes and/or shisha			
No	Ref	Ref	Ref
Yes	0.58 (0.46-0.74)	0.82 (0.66-1.01)	0.71 (0.61-0.83)
Site of data collection			
Public Spaces	Ref	Ref	Ref
Hospitals	1.40 (1.07-1.84)	1.27 (1.00-1.61)	1.11 (0.94-1.31)
Primary healthcare centers	1.48 (1.09-2.01)	0.93 (0.73-1.18)	1.36 (1.12-1.64)

COR= adjusted odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

1 Supplemental table 2: Bivariable logistic regression analyzing factors associated with the recognition of other risk factors.

Characteristic	Exposure to chemicals COR (95% CI)	Exposure to radiation COR (95% CI)	Air pollution COR (95% CI)
Age group			
18 to 44	Ref	Ref	Ref
45 or older	1.23 (1.04-1.46)	1.43 (1.21-1.71)	1.27 (1.07-1.51)
Gender			
Male	Ref	Ref	Ref
Female	1.07 (0.93-1.23)	0.90 (0.78-1.04)	0.97 (0.84-1.12)
Educational level			
Secondary or below	Ref	Ref	Ref
Post-secondary	1.11 (0.96-1.27)	1.46 (0.26-1.68)	1.05 (0.91-1.21)
Occupation			
Unemployed/housewife	Ref	Ref	Ref
Employed	0.84 (0.72-0.98)	1.27 (1.10-1.48)	1.05 (0.90-1.23)
Retired	1.10 (0.66-1.82)	3.82 (1.85-7.92)	1.34 (0.79-2.27)
Student	0.77 (0.61-0.98)	1.18 (0.93-1.51)	0.81 (0.64-1.03)
Monthly income			
< 1450 NIS	Ref	Ref	Ref
≥ 1450 NIS	1.19 (1.02-1.38)	1.33 (1.14-1.54)	1.45 (1.25-1.68)
Marital status			
Single	Ref	Ref	Ref
Married	1.16 (0.99-1.35)	1.24 (1.07-1.44)	1.10 (0.94-1.28)
Divorced/Widowed	0.96 (0.65-1.41)	1.06 (0.72-1.56)	0.95 (0.64-1.41)
Residency			
Gaza Strip	Ref	Ref	Ref
WBJ	1.18 (1.02-1.36)	1.05 (0.91-1.21)	1.59 (1.37-1.83)
Having a chronic disease			
No	Ref	Ref	Ref
Yes	1.21 (1.01-1.45)	1.20 (1.00-1.43)	1.30 (1.08-1.56)
Knowing someone with cancer			
No	Ref	Ref	Ref
Yes	1.59 (1.38-1.83)	1.54 (1.34-1.78)	1.49 (1.29-1.72)
Ever smoked cigarettes and/or shisha			
No	Ref	Ref	Ref
Yes	0.98 (0.84-1.14)	1.01 (0.87-1.18)	1.17 (1.00-1.37)
Site of data collection			
Public Spaces	Ref	Ref	Ref
Hospitals	1.67 (1.42-1.97)	1.01 (0.85-1.19)	1.37 (1.16-1.61)
Primary healthcare centers	2.04 (1.69-2.47)	0.97 (0.81-1.16)	1.49 (1.24-1.79)

53 COR= adjusted odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

Supplemental table 3: Bivariable logistic regression analyzing factors associated with the recognition of other risk factors.

Characteristic	Having a previous history of lung disease	Having a previous history of cancer	Having had treatment for any cancer in the past	Having a close relative with lung cancer
	COR (95% CI)	COR (95% CI)	COR (95% CI)	COR (95% CI)
Age group				
18 to 44	Ref	Ref	Ref	Ref
45 or older	1.16 (1.00-1.33)	1.20 (1.05-1.38)	0.97 (0.85-1.11)	1.15 (1.01-1.31)
Gender				
Male	Ref	Ref	Ref	Ref
Female	1.04 (0.92-1.18)	1.11 (0.99-1.25)	1.15 (1.02-1.28)	1.22 (1.09-1.37)
Educational level				
Secondary or below	Ref	Ref	Ref	Ref
Above secondary	1.07 (0.95-1.20)	0.89 (0.79-1.00)	1.08 (0.96-1.21)	1.10 (0.98-1.24)
Occupation				
Unemployed/housewife	Ref	Ref	Ref	Ref
Employed	1.08 (0.95-1.23)	0.88 (0.78-0.99)	0.90 (0.80-1.02)	1.04 (0.92-1.18)
Retired	1.39 (0.90-2.15)	1.56 (1.03-2.37)	0.95 (0.65-1.39)	1.09 (0.75-1.60)
Student	0.86 (0.70-1.05)	0.76 (0.62-0.93)	1.03 (0.85-1.26)	0.82 (0.67-1.00)
Monthly income				
1450 NIS	Ref	Ref	Ref	Ref
1450 NIS	0.91 (0.80-1.03)	1.02 (0.90-1.15)	0.96 (0.85-1.08)	1.15 (1.01-1.30)
Marital status				
Single	Ref	Ref	Ref	Ref
Married	1.15 (1.01-1.31)	1.19 (1.05-1.35)	1.11 (0.98-1.26)	1.01 (0.89-1.14)
Divorced/Widowed	1.09 (0.77-1.53)	1.38 (0.99-1.92)	0.95 (0.69-1.31)	1.11 (0.80-1.53)
Residency				
Gaza Strip	Ref	Ref	Ref	Ref
WBJ	0.93 (0.82-1.05)	1.05 (0.93-1.18)	0.95 (0.85-1.06)	1.20 (1.07-1.35)
Having a chronic disease				
No	Ref	Ref	Ref	Ref
Yes	1.09 (0.94-1.26)	1.17 (1.02-1.35)	0.91 (0.79-1.04)	1.10 (0.95-1.26)
Knowing someone with cancer				
No	Ref	Ref	Ref	Ref
Yes	1.08 (0.96-1.22)	1.38 (1.23-1.55)	1.21 (1.08-1.35)	1.10 (0.98-1.23)
Ever smoked cigarettes and/or shisha				
No	Ref	Ref	Ref	Ref
Yes	0.92 (0.81-1.05)	0.90 (0.79-1.02)	0.93 (0.82-1.05)	0.87 (0.76-0.98)
Site of data collection				
Public Spaces	Ref	Ref	Ref	Ref
Hospitals	1.28 (1.12-1.48)	1.37 (1.20-1.56)	1.12 (0.98-1.27)	1.03 (0.91-1.18)
Primary healthcare centers	1.46 (1.25-1.70)	1.73 (1.49-2.01)	1.61 (1.39-1.86)	1.13 (0.98-1.31)

COR= crude odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			**4**
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	N/A
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7-8
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(*e*) Describe any sensitivity analyses	N/A
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-9
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12-17
		(*b*) Report category boundaries when continuous variables were categorized	N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	21
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	21
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	22

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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1 **Current Situation and Future Directions of Lung Cancer Risk Factor Awareness in**

2 **Palestine: A Cross-sectional Study**

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1

1 **Word count:** 3465

2 **Abstract**

3 **Objectives:** To evaluate lung cancer (LC) risk factor awareness among Palestinians and identify

4 factors associated with good awareness.

5 **Design:** Cross-sectional study.

6 **Settings:** Participants were recruited using convenience sampling from hospitals, primary

7 healthcare centers, and public spaces located at 11 governorates in Palestine.

8 **Participants:** Of 5174 approached, 4817 participants completed the questionnaire (response

9 rate= 93.1%). A total of 4762 questionnaires were included: 2742 from the West Bank and

10 Jerusalem (WBJ) and 2020 from the Gaza Strip. Exclusion criteria were working or studying in a

11 health-related field, having a nationality other than Palestinian, and visiting oncology

12 departments or clinics at the time of data collection.

13 **Tool:** A modified version of the validated LC Awareness Measure was used for data collection.

14 **Primary and secondary outcomes:** The primary outcome was LC risk factor awareness level as

15 determined by the number of factors recognized: poor(0-3), fair(4-7), and good(8-10). Secondary

16 outcomes include the recognition of each LC risk factor.

17 **Results:** Smoking-related risk factors were more often recognized than other LC risk factors.

18 The most recognized risk factors were 'smoking cigarettes'(n=4466, 93.8%) and 'smoking

19 shisha [waterpipes]'(n=4337, 91.1%). The least recognized risk factors were 'having a close

2

1   relative with LC'(n=2084, 43.8%) and 'having had treatment for any cancer in the past'(n=2368,

2   49.7%).

3   A total of 2381 participants (50.0%) displayed good awareness of LC risk factors. Participants

4   from the WBJ and the Gaza Strip had similar likelihood to display good awareness (50.6% vs.

5   49.1%). Being ≥45 years, having higher education and monthly income, knowing someone with

6   cancer, and visiting hospitals and primary healthcare centers seemed to have a positive impact on

7   displaying good awareness.

8   **Conclusion:** Half of study participants displayed good awareness of LC risk factors. Educational

9   interventions are warranted to further improve public awareness of LC risk factors, especially

10   those unrelated to smoking.

11   **Keywords:** lung cancer, risk factors, behavioral changes, prevention, early detection, early

12   diagnosis, health education, awareness, Palestine.

13   **Strengths and limitations of this study**

14   • The large sample size was a major strength of this study.

15   • The wide coverage of the major geographical areas of Palestine and collecting data from

16   different places within each area allowed for direct evaluation of the knowledge of LC

17   risk factors at various levels in the Palestinian population.

18   • The use of convenience sampling does not guarantee the generalizability of the findings.

3

- Visitors or patients in the oncology departments as well as those with medical backgrounds were all ineligible, which might have reduced the number of participants with a presumably good awareness.

- Grouping unemployed women and housewives in the same category might be inappropriate, as this may include women with a whole range of socioeconomic and educational background from highly-educated women who chose to focus on family care to those with minimal skills who cannot find work and look after their family as the default option.

Introduction

Lung cancer (LC) is the leading cause of cancer-related deaths worldwide with 18.0% of cancer-related deaths and over 2.2 million newly diagnosed cases in 2020.[1] In the Middle East and North Africa, the estimated number of newly diagnosed LC cases was 79,887 in 2018 with a 5-year relative survival rate of 8.0%.[2] In Palestine, LC is the second most common cancer, accounting for 11.4% of all cancers with an incidence rate of 11.5 per 100,000 general population, and the leading cause of cancer-related mortality accounting for 17.3%.[3]

The most significant risk factor for LC is smoking tobacco products including cigarettes and shisha (waterpipes).[4] Tobacco smoking was reported to be prevalent among 47.7% of Palestinians in the West Bank. Men were found to smoke more than women and to begin smoking at an earlier age, where 74.4% of smokers started when they were 18 years old or younger. Cigarettes and shisha were found to be the most popular methods of smoking among Palestinian men and women.[5]

4

1 Besides smoking, there are LC risk factors for LC, such as exposure to radiation, occupational

2 hazards like asbestos, air pollution and family history of LC.[6-8] However, previous studies

3 showed that awareness of smoking-related risk factors of LC was higher than that of other LC

4 risk factors.[9-11]

5 One of the most important contributors to the low survival rates of LC is delayed presentation.

6 This could be due to factors related to patients, healthcare providers, the healthcare system, or

7 the disease itself.[12] Awareness of LC risk factors is one of the patient-related factors.

8 Recognition of LC risk factors can help stimulating the development of an active personal risk

9 assessment, which in turn increases the ability to detect and react to related symptoms.[13]

10 Previous studies demonstrated that raising the public awareness of LC increased the number of

11 individuals diagnosed at early stages.[14-16] An early diagnosis of LC contributes to better

12 prognosis.[17] Given the limited resources in Palestine, such educational interventions could be

13 an efficient strategy to mitigate the mortality associated with LC.

14 Therefore, the primary aim of this national study was to evaluate the overall LC risk factor

15 awareness among Palestinians. Secondary aims were to examine if there is a difference in the LC

16 risk factor awareness between the two main areas of Palestine [the West Bank and Jerusalem

17 (WBJ) and the Gaza Strip] and to identify the sociodemographic factors associated with good

18 awareness.

5

1   **Methods**

2   *Study design and population*

3   This was a national cross-sectional study conducted from July 2019 to March 2020. Palestinian

4   adults (≥ 18 years) were the target population. Participants were recruited from governmental

5   hospitals, primary healthcare centers (PHCs) and public spaces, such as malls, markets,

6   restaurants, mosques, churches, parks, downtowns, transportation stations and others. Exclusion

7   criteria were working or studying in a health-related field, having a nationality other than

8   Palestinian, and visiting oncology departments or clinics at the time of data collection.

9   *Sampling methods*

10 Eligible participants were recruited to the study using a convenience sampling technique from

11 governmental hospitals, PHCs, and public spaces located in 11 governorates (out of 16) across

12 Palestine between July 2019 and March 2020. This was intended to create a diverse study cohort

13 resembling the Palestinian community.[18-20] In 2019, the estimated Palestinian population

14 (≥15 years) was 3,109,063. With a confidence level of 95.0%, a type I error rate of 5.0%, and an

15 absolute error of 1.0%, the minimum required sample size to detect a good overall LC risk factor

16 awareness of 50% was 2401 participants.

17 *Questionnaire and data collection*

18 A modified version of the LC Awareness Measure (LCAM) was used for data collection. The

19 LCAM is a validated tool that was designed to evaluate the public awareness of LC.[13] The

20 original LCAM was first translated into Arabic by two bilingual healthcare professionals and

6

1 then back-translated into English by another two different bilingual healthcare professionals. The

2 Arabic version of the LCAM was then assessed for content validity and accuracy of translation

3 by three experts in the field of thoracic oncology, public health, and survey design. This was

4 followed by a pilot study (n= 68) to assess the clarity of questions in the Arabic version of the

5 LCAM. The questionnaires of the pilot study were not included in the final analysis. The

6 Cronbach's Alpha was used to assess the internal consistency of the Arabic LCAM and it

7 reached an acceptable value of 0.784.

8 The Arabic LCAM included two sections. The first section described the sociodemographic

9 factors of study participants. The second section evaluated the awareness of 10 LC risk factors

10 using a 5-point Likert scale (1=strongly disagree, 5=strongly agree). Of the 10 risk factors, nine

11 were mentioned in the original LCAM.[13] 'Smoking shisha' was added to the questionnaire as

12 it was deemed important to assess the awareness of this risk factor in the Palestinian community

13 due to its high prevalence.[5]

14 The electronic tool 'Kobo Toolbox' was utilized in the data collection.[21] This safe tool can be

15 used both offline and online on mobile devices. Data collectors completed the questionnaire in a

16 face-to-face interview with the participant using Kobo Toolbox. The data collectors had medical

17 background and received special training on the use of Kobo Toolbox, recruitment of potential

18 study participants, gaining informed consent, and facilitation of completion of the questionnaires.

19 *Statistical analysis*

20 The percentage of new LC cases increases substantially starting from the age of 45.[22] Therefore,

21 participants' age was categorized into two categories using this cutoff: 18-44 years and ≥45 years.

7

1 The monthly income was also categorized into two categories (<1450 NIS and ≥1450 NIS) since

2 1450 NIS (about $450) is the minimum wage in Palestine.[23]

3 The median and interquartile range (IQR) were used to describe continuous, non-normally

4 distributed variables and the Kruskal-Wallis test was used for baseline comparisons. Frequencies

5 and percentages were used to describe categorical variables and Pearson's Chi-square test was used

6 for baseline comparisons.

7 The recognition of each LC risk factor was assessed using a question based on a 5-point Likert

8 scale with 'strongly agree' or 'agree' as a correct answer, and 'strongly disagree', 'disagree', or

9 'not sure' as an incorrect answer. For each correctly recognized LC risk factor, one point was

10 given. LC risk factors were further categorized into two categories: (i) smoking-related and (ii)

11 other risk factors. Recognition of LC risk factors was described using frequencies and percentages

12 with comparisons performed by Pearson's Chi-Square test. This was followed by running

13 univariable and multivariable logistic regression analyses to examine the association between

14 recognizing each LC risk factor and participant characteristics. The multivariable analysis adjusted

15 for age group, gender, educational level, monthly income, occupation, place of residency, marital

16 status, having a chronic disease, knowing someone with cancer, smoking history, and site of data

17 collection. This model was determined a priori based on previous studies.[13, 24-27] The results

18 of the univariable analyses are presented in supplementary tables 1 to 3, please see additional file

19 1.

20 A scoring system was used to evaluate the participants' awareness level of LC risk factors. Similar

21 scoring systems were also used in previous studies.[18, 27-28] For each correctly recognized LC

22 risk factor, one point was given. The total score (ranging from 0 to 10) was calculated and

8

1 categorized based on the number of recognized LC risk factors into three categories: poor (0 to 3),

2 fair (4 to 7), and good awareness (8 to 10). The awareness level of LC risk factors exhibited by

3 participants from the Gaza Strip was compared with the awareness level exhibited by participants

4 from the WBJ using Pearson's Chi-Square test. Univariable and multivariable logistic regression

5 analyses were utilized to test the association between participant characteristics and having a good

6 awareness level.

7 For all multivariable analyses, the likelihood ratio test was utilized to calculate the overall p-value

8 for each independent variable. Missing data were hypothesized to be missed completely at random

9 and thus, complete case analysis was utilized to handle them. Data were analyzed using Stata

10 software version 16.0 (StataCorp, College Station, Texas, United States).

11 *Patients and public involvement*

12 There was no patient or public involvement in the design, conduct, reporting, or dissemination

13 plans of this study. However, results will be disseminated among the professional communities of

14 Palestine and to policymakers, with the intent to inform future health policy decisions.

15 **Results**

16 *Participant characteristics*

17 Of 5174 approached, 4817 participants completed the questionnaire (response rate= 93.1%). In

18 total, 4762 questionnaires were included in the analysis (24 were ineligible and 31 had missing

19 data): 2742 from the WBJ and 2020 from the Gaza Strip. The median age [IQR] for all

20 participants was 32.0 years [24.0, 44.0] (table 1). Participants living in the WBJ were more likely

9

1   to be older, have higher monthly income but lower level of education, and suffer more often

2   from chronic diseases than participants living in the Gaza Strip.

Table 1: Characteristics of study participants.

Characteristic	Total (n= 4762)	Gaza Strip (n= 2020)	WBJ (n= 2742)	p-value
Age, median [IQR]	32.0 [24.0, 44.0]	30.0 [24.0, 40.0]	34.0 [24.0, 47.0]	<0.001
Age group, n (%)				<0.001
18 to 44	3572 (75.0)	1634 (80.9)	1938 (70.7)	
45 or older	1190 (25.0)	386 (19.1)	804 (29.3)	
Female gender, n (%)	2618 (55.0)	1086 (53.8)	1532 (55.9)	0.15
Educational level, n (%)				
Secondary or below	2375 (49.9)	955 (47.3)	1420 (51.8)	0.002
Post-secondary	2387 (50.1)	1065 (52.7)	1322 (48.2)	
Occupation, n (%)				
Unemployed/housewife	2003 (42.1)	970 (48.0)	1033 (37.7)	<0.001
Employed	2160 (45.4)	814 (40.3)	1346 (49.1)	
Retired	111 (2.3)	46 (2.3)	65 (2.4)	
Student	488 (10.2)	190 (9.4)	298 (10.8)	
Monthly income ≥ 1450 NIS, n (%)	3241 (68.1)	683 (33.8)	2558 (93.3)	<0.001
Marital status, n (%)				
Single	1480 (31.1)	641 (31.7)	839 (30.6)	0.07
Married	3117 (65.5)	1323 (65.5)	1794 (65.4)	
Divorced/Widowed	165 (3.5)	56 (2.8)	109 (4.0)	
Having a chronic disease, n (%)	1032 (21.7)	313 (15.5)	719 (26.2)	<0.001
Knowing someone with cancer, n (%)	2571 (54.0)	1045 (51.7)	1526 (55.7)	0.007
Ever smoked, n (%)				
Cigarettes	1127 (23.7)	417 (20.6)	710 (25.9)	<0.001
Shisha (waterpipes)	499 (10.5)	142 (7.0)	357 (13.0)	<0.001
Site of data collection, n (%)				
Public Spaces	1920 (40.3)	784 (38.8)	1136 (41.4)	<0.001
Hospitals	1628 (34.2)	651 (32.2)	977 (35.7)	
Primary healthcare centers	1214 (25.5)	585 (29.0)	629 (22.9)	

n= number of participants, IQR= interquartile range, WBJ= West Bank and Jerusalem.

1   *Recognition of LC risk factors*

2   Smoking-related risk factors were more often recognized than other LC risk factors. The most

3   frequently identified risk factors were 'smoking cigarettes' (n= 4466, 93.8%) and 'smoking

4   shisha' (n= 4337, 91.1%) (table 2). These risk factors were the most identified in both the WBJ

5   and the Gaza Strip. The least recognized risk factors were 'having a close relative with LC' (n=

6   2084, 43.8%) and 'having had treatment for any cancer in the past' (n= 2368, 49.7%). These risk

7   factors were also the least identified in both the WBJ and the Gaza Strip.

Table 2: Recognition of lung cancer risk factors.

Factor	Total (n= 4762) n (%)	Gaza Strip (n= 2020) n (%)	WBJ (n= 2742) n (%)	p-value
Smoking-related risk factors				
Smoking cigarettes	4466 (93.8)	1892 (93.7)	2574 (93.9)	0.77
Smoking shisha	4337 (91.1)	1822 (90.2)	2515 (91.7)	0.07
Exposure to another person's cigarette smoke	3867 (81.2)	1621 (80.2)	2246 (81.9)	0.15
Other risk factors				
Air pollution	3838 (80.6)	1543 (76.4)	2295 (83.7)	<0.001
Exposure to chemicals (e.g., asbestos)	3802 (79.8)	1582 (78.3)	2220 (81.0)	0.024
Exposure to radiation	3788 (79.6)	1598 (79.1)	2190 (79.9)	0.52
Having a previous history of lung disease (e.g., COPD)	3216 (67.5)	1382 (68.4)	1834 (66.9)	0.27
Having a previous history of cancer such as head and neck cancer	2778 (58.3)	1165 (57.7)	1613 (58.8)	0.43
Having had treatment for any cancer in the past	2368 (49.7)	1020 (50.5)	1348 (49.2)	0.36
Having a close relative with lung cancer	2084 (43.8)	832 (41.2)	1252 (45.7)	0.002

n= number of participants. WBJ= West Bank and Jerusalem, COPD= chronic obstructive pulmonary disease.

11

1 *Good awareness and its associated factors*

2 A total of 2381 participants (50.0%) displayed good awareness (prompt recognition of more than

3 seven out of 10 LC risk factors) (table 3). Participants from the WBJ and the Gaza Strip had a

4 similar likelihood to display good awareness (50.6% vs. 49.1%). On the multivariable analysis,

5 being ≥ 45 years, having higher education and monthly income, knowing someone with cancer,

6 and visiting hospitals and PHCs were all associated with an increase in the likelihood of having a

7 good awareness level of LC risk factors (table 4).

Table 3: Awareness level of lung cancer risk factors among study participants.

Level	Total n (%)	Gaza Strip n (%)	WBJ n (%)	p-value
Poor (0-3 risk factors)	203 (4.3)	111 (5.5)	92 (3.4)	
Fair (4-7 risk factors)	2178 (45.7)	918 (45.4)	1260 (46.0)	0.001
Good (8-10 risk factors)	2381 (50.0)	991 (49.1)	1390 (50.6)	

n= number of participants, WBJ= West Bank and Jerusalem.

12

Table 4: Univariable and multivariable logistic regression analyzing factors associated with having a good awareness of lung cancer risk factors.

Characteristic	Good awareness			
	COR (`95% CI)	p-value#	AOR (95% CI)*	p-value#
Age group				
18 to 44	Ref	<0.001	Ref	0.026
45 or older	1.33 (1.17- 1.52)		1.20 (1.02- 1.42)	
Gender				
Male	Ref	0.014	Ref	0.36
Female	1.15 (1.03-1.29)		1.08 (0.91-1.28)	
Educational level				
Secondary or below	Ref	0.016	Ref	<0.001
Post-secondary	1.15 (1.03-1.29)		1.25 (1.09-1.42)	
Occupation				
Unemployed/housewife	Ref	0.011	Ref	0.17
Employed	0.98 (0.87-1.11)		1.16 (0.99-1.36)	
Retired	1.49 (1.01-2.19)		1.34 (0.87-2.04)	
Student	0.79 (0.64-0.95)		0.98 (0.77-1.24)	
Monthly income				
< 1450 NIS	Ref	0.027	Ref	0.041
≥ 1450 NIS	1.15 (1.02-1.30)		1.19 (1.07-1.411)	
Marital status				
Single	Ref	0.001	Ref	0.97
Married	1.25 (1.11-1.41)		1.01 (0.87-1.17)	
Divorced/Widowed	1.30 (0.95-1.80)		1.05 (0.74-1.49)	
Residency				
Gaza Strip	Ref	0.27	Ref	0.53
WBJ	1.07 (0.95-1.20)		0.95 (0.81-1.11)	
Having a chronic disease				
No	Ref	<0.001	Ref	0.09
Yes	1.32 (1.16-1.52)		1.15 (0.98-1.35)	
Knowing someone with cancer				
No	Ref	<0.001	Ref	<0.001
Yes	1.52 (1.35-1.70)		1.61 (1.43-1.81)	
Ever smoked cigarettes and/or shisha				
No	Ref	0.043	Ref	0.12
Yes	0.88 (0.78-1.00)		0.88 (0.75-1.03)	
Site of data collection				
Public Spaces	Ref	<0.001		<0.001

13

Hospitals	1.37 (1.20-1.56)	Ref
Primary healthcare centers	1.79 (1.55-2.07)	1.46 (1.27-1.68)
		2.04 (1.73-2.40)

COR= crude odds ratio, AOR= adjusted odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

*Adjusted for age-group, gender, educational level, occupation, monthly income, marital status, residency, having a chronic disease, knowing someone with cancer, smoking history, and site of data collection.

#p-value of likelihood ratio test.

1 *Association between recognizing smoking-related risk factors and participant characteristics*

2 Our data suggested an association between education level and recognition of smoking-related

3 risk factors, where participants with higher education level (above secondary) seemed to be more

4 likely than other participants to recognize all smoking-related risk factors (supplementary table

5 4). In addition, there seemed to be an impact of visiting hospitals and PHCs on recognizing

6 'smoking cigarettes' as an LC risk factor. Similarly, participants from the WBJ seemed to be

7 more likely than participants from the Gaza Strip to recognize 'smoking shisha' and 'exposure to

8 another person's cigarette smoke' as LC risk factors. In contrast, participants who ever smoked

9 cigarettes and/or shisha seemed to be less likely than participants who never smoked to recognize

10 all smoking-related risk factors.

11 *Association between recognizing other LC risk factors and participant characteristics*

12 Our data suggested an association between knowing someone with cancer and recognizing most

13 other LC risk factors, where participants who knew someone with cancer were more likely to

14 recognize 'exposure to chemicals', 'exposure to radiation', 'air pollution', 'having a previous

15 history of cancer', and 'having had treatment for any cancer in the past' as LC risk factors

16 (supplementary table 5). In addition, there seemed to be an impact of visiting hospitals and PHCs

17 on recognizing 'exposure to chemicals', 'air pollution', 'having a previous history of lung

18 disease', 'having a previous history of cancer', and 'having had treatment for any cancer in the

19 past' as LC risk factors.

14

1 **Discussion**

2 Half of the study participants demonstrated good awareness of LC risk factors, defined as

3 recognizing more than seven out of the 10 LC risk factors. Participants from the WBJ and the

4 Gaza Strip demonstrated a similar likelihood of having a good awareness level. The factors that

5 seemed to have an impact on displaying good awareness levels of LC risk factors were being ≥45

6 years, higher levels of education and monthly income, knowing someone with cancer, and

7 visiting hospitals and PHCs. Smoking-related risk factors were more often recognized than other

8 risk factors. The most frequently recognized LC risk factor was 'smoking cigarettes' followed

9 by 'smoking shisha'. Interestingly, participants who ever smoked seemed to be less likely to

10 recognize smoking-related risk factors than those who never smoked.

11 Awareness of LC risk factors among Palestinians was higher than knowledge of other types of

12 cancer.[18-20] Only 17.4% of Palestinians displayed good knowledge of ovarian cancer

13 symptoms,[20] 23.7% had good knowledge of cervical cancer risk factors[19] and 27.4%

14 demonstrated good knowledge of cervical cancer warning signs.[18]

15 The majority of LC cases are diagnosed late, which may be in part due to a lack of awareness of

16 LC symptoms, fear of cancer diagnosis, worries about what might be found, and lack of time to

17 visit a doctor.[28-29] Educational interventions that raise the knowledge about various aspects of

18 LC awareness are critical to develop behaviors that lead to the prevention and early diagnosis of

15

1   LC.[30] The high mortality rate of LC, especially in low-resource settings like Palestine [31] and

2   the high smoking rates, ranging from 30.0% to 47.7%,[5, 32-33] necessitate finding approaches

3   to increase awareness of LC risk factors. Although there are tobacco control policies in

4   Palestine,[34] there is a substantial need to monitor their outreach and implementation more

5   closely. This is especially important given the widespread availability of tobacco products on all

6   premises in public and to all ages. Such monitoring of the implementation of government

7   tobacco control policies was shown to discourage people from smoking, which could reduce both

8   active and passive smoking and, thus, LC morbidity and mortality.[35-36] There are several

9   barriers to implementing tobacco control policies in Palestine. The lack of enforcement of these

10   polices is a major barrier. It is common to see someone smoking in a public place or to see a

11   child who is under 18 years going to a store to buy a pack of cigarettes for their own use or for

12   the use of one of their family members. The law also did not specify the penalties for violating

13   these policies, which limits the adherence of the public. In addition, to the best of our knowledge,

14   there are no specialized centers to help smokers quit smoking. Finally, the poor economic

15   circumstances could be a contributing factor for the inability to implement tobacco control

16   policies as their enforcement requires allocation of a special budget for that purpose.

17   *Awareness of LC risk factors*

18   Smoking cigarettes was the most recognized LC risk factor in this study followed by smoking

19   shisha and exposure to another person's cigarette smoke (passive smoking), respectively. In a

20   previous study from Oman, smoking cigarettes was the most recognized LC risk factor (79.8%)

21   and passive smoking was the third (55.7%).[9] Similarly, in a previous study from Jordan, the

1 majority believed that active cigarette smoking, shisha smoking, and passive smoking were all

2 linked to cancer.[37]

3 Musmar and colleagues reported that 34.7% of university students in Palestine were current

4 smokers.[33] Students in the arts and humanities were found to have a considerably greater risk

5 of smoking than students in the sciences or in healthcare.[33] The fact that health sciences

6 students were found to be less likely to smoke might be partly due to the influence of smoking-

7 related health education.[33] This is also supported by the findings of this study, where

8 participants who had never smoked seemed to be more likely to demonstrate good awareness of

9 smoking-related risk factors than ever smokers, highlighting the potentially empowering

10 influence of health education on smoking behavior.

11 Chapple and colleagues found that LC patients felt unjustly blamed for their disease. LC patients

12 felt particularly stigmatized regardless of their smoking status, because the condition is closely

13 linked to smoking, which negatively impacted their interaction with family, friends, and

14 physicians.[38] Such stigma may drive individuals who have a possible LC symptom

15 accompanied by risk factors to seek medical advice late, and thus, lead to diagnoses at advanced

16 stages. Health practitioners who have contact with current and former smokers must be well

17 trained to offer a safe and non-judgmental environment for people who arrive with symptoms

18 suggestive of LC.[26]

19 Chawla and colleagues showed that having benefitted from post-secondary education was a main

20 factor associated with good awareness of LC risk factors,[39] which comes in concordance with

21 this study. Educational levels in Palestine are good and the illiteracy rate is low at only 2.5%

22 [40], which could contribute to the fair awareness of LC risk factors found in this study,

17

1 compared with the lower levels in other regional studies.[37, 41] Participants who benefitted

2 from higher education appear to be more concerned about their health and more likely to avoid

3 risky behaviors such as smoking.[42-43] Future educational interventions aiming to raise

4 awareness of LC risk factors should be tailored to match the level of health literacy among

5 individuals with low education.

6 While many similarities existed in the LC awareness of participants in the Gaza Strip compared

7 with those in the WBJ, such as the likelihood to have good awareness of LC risk factors and

8 recognition of smoking cigarettes as a risk factor, there were a few differences. Among these

9 were that participants in the WBJ seemed to be more likely to recognize 'passive smoking',

10 'shisha smoking', 'air pollution', and 'having a close relative with cancer' as risk factors than

11 participants from the Gaza Strip. Residents of the Gaza Strip are not allowed to travel to the WBJ

12 and likewise are residents from the WBJ not allowed to travel to the Gaza Strip. These

13 movement restrictions hinder the exchange of ideas, knowledge and health beliefs among people

14 of both areas. However, the overall greater number of similarities might be encouraging, when

15 considering the delivery of educational interventions to the whole population. The unified school

16 curriculum might be one such way of content delivery and health education and, hence,

17 increasing awareness of LC risk factors among the Palestinian population.

18 *Future directions*

19 Public health interventions that aim to promote the recognition of LC risk factors may have a

20 major potential to improve LC outcomes for those most at risk in an attempt to reduce patient-

21 related delays to diagnosis. The creation of widespread public education programs and enriching

22 school curricula with subjects outlining important symptoms and risk factors of LC may also

1   play a role. However, this might need to be complemented by effective implementation of

2   tobacco control regulations to achieve the greatest impact. This is especially important in low-

3   and middle-income countries, such as Palestine, where access to treatment might otherwise be

4   delayed and outcomes are poorer.

5   *Strengths and limitations*

6   The major strengths of this study include the large sample size and the wide geographical

7   coverage of data collection from different places within each main area, which allowed direct

8   evaluation of the knowledge of LC risk factors at various levels in the Palestinian population.

9   This study has some limitations though. The use of convenience sampling does not guarantee the

10   generalizability of the findings. However, the large number of participants, the diversity of

11   geographical areas included, and the high response rate may mitigate this. Another limitation

12   could be that visitors or patients in the oncology departments as well as those with medical

13   backgrounds were all ineligible, which might have reduced the number of participants with a

14   presumably good awareness. Nevertheless, this was intended to make the measured awareness

15   more relevant to the overall public awareness, as people being treated in oncology departments

16   and those visiting such departments were presumed to have better knowledge, compared with the

17   general public without the same contact with healthcare professionals. A further limitation in our

18   questionnaire could be grouping unemployed women and housewives in the same category,

19   while women not in employment may include a whole range of socioeconomic and educational

20   background from those with minimal skills who cannot find work and look after their family as

21   the default option to highly educated women who choose to focus on family care. Finally, the

22   results of the multivariable analyses in this study are exploratory and need further validation.

19

1 *Conclusion*

2 Awareness of LC risk factors was relatively good with half of the participants displaying good

3 awareness. Smoking-related risk factors were the most recognized risk factors. Older age, higher

4 education, higher monthly income, knowing someone with cancer and visiting healthcare

5 facilities seemed to have a positive impact on displaying good awareness. Formulation and

6 effective implementation of tobacco control policies are essential to change smoking behavior

7 and increase awareness. This should be complemented by educational initiatives to improve

8 public understanding of LC and the perception of smoking danger. Such interventions are

9 especially useful in low-resource settings, such as Palestine, where access to diagnosis and

10 treatment is limited.

11 **Other information**

12 **Data statement:** Data are available upon reasonable request.

13 **Ethical considerations:** Prior to data collection, ethical approval had been obtained from the

14 Human Resources Development Department at the Palestinian Ministry of Health and the

15 Helsinki Committee in the Gaza Strip on the 24th of June, 2017. In addition, another approval

16 was obtained from the Research Ethics Committee at the Islamic University of Gaza on the 26th

17 of June, 2017. The participants had a thorough explanation about the study purposes with the

18 focus that their participation was completely voluntary. Written informed consent was taken

19 from study participants before starting the questionnaire and data were collected anonymously.

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Current Situation and Future Directions of Lung Cancer Risk Factor Awareness in Palestine: A Cross-sectional Study

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Supplemental table 1: Univariable logistic regression analyzing factors associated with the recognition of smoking-related risk factors.

Characteristic	Smoking cigarettes		Smoking shisha		Exposure to another person's cigarette smoke	
	COR (95% CI)	p	COR (95% CI)	p	COR (95% CI)	p
Age group						
18 to 44	Ref	Ref	Ref	Ref	Ref	Ref
45 or older	0.76 (0.59-0.98)	0.038	1.09(0.86-1.38)	0.47	1.09 (0.92-1.29)	0.32
Gender						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	1.27 (1.01-1.61)	0.044	0.77 (0.63-0.95)	0.013	1.25 (1.08-1.45)	0.002
Educational level						
Secondary or below	Ref	Ref	Ref	Ref	Ref	Ref
Above secondary	1.76 (1.38-2.24)	<0.001	1.71 (1.39-2.10)	<0.001	1.18 (1.02-1.36)	0.028
Occupation						
Unemployed/housewife	Ref	Ref	Ref	Ref	Ref	Ref
Employed	0.98(0.76-1.25)	0.84	1.31 (1.06-1.62)	0.013	0.91 (0.78-1.07)	0.26
Retired	1.41 (0.57-3.52)	0.46	2.01 (0.87-4.62)	0.10	1.11 (0.66-1.87)	0.69
Student	1.09 (0.72-1.67)	0.68	1.32 (0.92-1.89)	0.13	0.74 (0.58-0.94)	0.015
Monthly income						
< 1450 NIS	Ref	Ref	Ref	Ref	Ref	Ref
≥ 1450 NIS	1.02 (0.80-1.32)	0.85	1.26 (1.03-1.55)	0.028	0.98 (0.84-1.15)	0.82
Marital status						
Single	Ref	Ref	Ref	Ref	Ref	Ref
Married	1.11 (0.86-1.43)	0.44	0.98 (0.79-1.22)	0.87	1.23 (1.05-1.44)	0.009
Divorced/Widowed	0.53 (0.31-0.89)	0.016	0.58 (0.36-0.94)	0.027	1.06 (0.71-1.58)	0.78
Residency						
Gaza Strip	Ref	Ref	Ref	Ref	Ref	Ref
WBJ	1.04 (0.82-1.31)	0.77	1.20(0.99-1.47)	0.07	1.11 (0.96-1.29)	0.15
Having a chronic disease						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.77 (0.59-1.01)	0.06	0.90 (0.71-1.14)	0.40	1.09 (0.91-1.31)	0.32
Knowing someone with cancer						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.04 (0.82-1.32)	0.74	1.04 (0.85-1.27)	0.72	1.12 (0.97-1.30)	0.12
Ever smoked cigarettes and/or shisha						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.58 (0.46-0.74)	<0.001	0.82 (0.66-1.01)	0.07	0.71 (0.61-0.83)	<0.001
Site of data collection						
Public Spaces	Ref	Ref	Ref	Ref	Ref	Ref
Hospitals	1.40 (1.07-1.84)	0.015	1.27 (1.00-1.61)	0.054	1.11 (0.94-1.31)	0.22
Primary healthcare centers	1.48 (1.09-2.01)	0.012	0.93 (0.73-1.18)	0.53	1.36 (1.12-1.64)	0.002

COR= crude odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

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Supplemental table 2: Univariable logistic regression analyzing factors associated with the recognition of other risk factors.

Characteristic	Exposure to chemicals		Exposure to radiation		Air pollution	
	COR (95% CI)	p	COR (95% CI)	p	COR (95% CI)	p
Age group						
18 to 44	Ref	Ref	Ref	Ref	Ref	Ref
45 or older	1.23 (1.04-1.46)	0.016	1.43 (1.21-1.71)	<0.001	1.27 (1.07-1.51)	0.007
Gender						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	1.07 (0.93-1.23)	0.35	0.90 (0.78-1.04)	0.16	0.97 (0.84-1.12)	0.71
Educational level						
Secondary or below	Ref	Ref	Ref	Ref	Ref	Ref
Above secondary	1.11 (0.96-1.27)	0.17	1.46 (0.26-1.68)	<0.001	1.05 (0.91-1.21)	0.50
Occupation						
Unemployed/housewife	Ref	Ref	Ref	Ref	Ref	Ref
Employed	0.84 (0.72-0.98)	0.023	1.27 (1.10-1.48)	0.002	1.05 (0.90-1.23)	0.50
Retired	1.10 (0.66-1.82)	0.72	3.82 (1.85-7.92)	<0.001	1.34 (0.79-2.27)	0.28
Student	0.77 (0.61-0.98)	0.032	1.18 (0.93-1.51)	0.18	0.81 (0.64-1.03)	0.09
Monthly income						
< 1450 NIS	Ref	Ref	Ref	Ref	Ref	Ref
≥ 1450 NIS	1.19 (1.02-1.38)	0.023	1.33 (1.14-1.54)	<0.001	1.45 (1.25-1.68)	<0.001
Marital status						
Single	Ref	Ref	Ref	Ref	Ref	Ref
Married	1.16 (0.99-1.35)	0.06	1.24 (1.07-1.44)	0.005	1.10 (0.94-1.28)	0.24
Divorced/Widowed	0.96 (0.65-1.41)	0.83	1.06 (0.72-1.56)	0.77	0.95 (0.64-1.41)	0.79
Residency						
Gaza Strip	Ref	Ref	Ref	Ref	Ref	Ref
WBJ	1.18 (1.02-1.36)	0.025	1.05 (0.91-1.21)	0.50	1.59 (1.37-1.83)	<0.001
Having a chronic disease						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.21 (1.01-1.45)	0.035	1.20 (1.00-1.43)	0.044	1.30 (1.08-1.56)	0.006
Knowing someone with cancer						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.59 (1.38-1.83)	<0.001	1.54 (1.34-1.78)	<0.001	1.49 (1.29-1.72)	<0.001
Ever smoked cigarettes and/or shisha						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.98 (0.84-1.14)	0.81	1.01 (0.87-1.18)	0.87	1.17 (1.00-1.37)	0.054
Site of data collection						
Public Spaces	Ref	Ref	Ref	Ref	Ref	Ref
Hospitals	1.67 (1.42-1.97)	<0.001	1.01 (0.85-1.19)	0.95	1.37 (1.16-1.61)	<0.001
Primary healthcare centers	2.04 (1.69-2.47)	<0.001	0.97 (0.81-1.16)	0.75	1.49 (1.24-1.79)	<0.001

COR= adjusted odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

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Supplemental table 3: Univariable logistic regression analyzing factors associated with the recognition of other risk factors.

Characteristic	Having a previous history of lung disease		Having a previous history of cancer		Having had treatment for any cancer in the past		Having a close relative with lung cancer	
	COR (95% CI)*	p	COR (95% CI)*	p	COR (95% CI)*	p	COR (95% CI)*	p
Age group								
18 to 44	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
45 or older	1.16 (1.00-1.33)	0.043	1.20 (1.05-1.38)	0.007	0.97 (0.85-1.11)	0.65	1.15 (1.01-1.31)	0.042
Gender								
Male	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Female	1.04 (0.92-1.18)	0.50	1.11 (0.99-1.25)	0.08	1.15 (1.02-1.28)	0.019	1.22 (1.09-1.37)	0.001
Educational level								
Secondary or below	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Above secondary	1.07 (0.95-1.20)	0.29	0.89 (0.79-1.00)	0.043	1.08 (0.96-1.21)	0.20	1.10 (0.98-1.24)	0.12
Occupation								
Unemployed/housewife	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Employed	1.08 (0.95-1.23)	0.27	0.88 (0.78-0.99)	0.041	0.90 (0.80-1.02)	0.09	1.04 (0.92-1.18)	0.51
Retired	1.39 (0.90-2.15)	0.13	1.56 (1.03-2.37)	0.036	0.95 (0.65-1.39)	0.79	1.09 (0.75-1.60)	0.64
Student	0.86 (0.70-1.05)	0.15	0.76 (0.62-0.93)	0.007	1.03 (0.85-1.26)	0.76	0.82 (0.67-1.00)	0.06
Monthly income								
<1450 NIS	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
≥1450 NIS	0.91 (0.80-1.03)	0.15	1.02 (0.90-1.15)	0.79	0.96 (0.85-1.08)	0.50	1.15 (1.01-1.30)	0.030
Marital status								
Single	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Married	1.15 (1.01-1.31)	0.033	1.19 (1.05-1.35)	0.006	1.11 (0.98-1.26)	0.09	1.01 (0.89-1.14)	0.89
Divorced/Widowed	1.09 (0.77-1.53)	0.63	1.38 (0.99-1.92)	0.06	0.95 (0.69-1.31)	0.74	1.11 (0.80-1.53)	0.53
Residency								
Gaza Strip	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
WBJ	0.93 (0.82-1.05)	0.27	1.05 (0.93-1.18)	0.43	0.95 (0.85-1.06)	0.36	1.20 (1.07-1.35)	0.002
Having a chronic disease								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.09 (0.94-1.26)	0.26	1.17 (1.02-1.35)	0.027	0.91 (0.79-1.04)	0.18	1.10 (0.95-1.26)	0.21
Knowing someone with cancer								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.08 (0.96-1.22)	0.20	1.38 (1.23-1.55)	<0.001	1.21 (1.08-1.35)	0.001	1.10 (0.98-1.23)	0.11
Ever smoked cigarettes and/or shisha								
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.92 (0.81-1.05)	0.21	0.90 (0.79-1.02)	0.10	0.93 (0.82-1.05)	0.23	0.87 (0.76-0.98)	0.026
Site of data collection								
Public Spaces	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Hospitals	1.28 (1.12-1.48)	<0.001	1.37 (1.20-1.56)	<0.001	1.12 (0.98-1.27)	0.10	1.03 (0.91-1.18)	0.63
Primary healthcare centers	1.46 (1.25-1.70)	<0.001	1.73 (1.49-2.01)	<0.001	1.61 (1.39-1.86)	<0.001	1.13 (0.98-1.31)	0.10

COR= crude odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

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Current Situation and Future Directions of Lung Cancer Risk Factor Awareness in Palestine: A Cross-sectional Study

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Supplementary table 4: Multivariable logistic regression analyzing factors associated with the recognition of smoking-related risk factors.

Characteristic	Smoking cigarettes		Smoking shisha		Exposure to another person's cigarette smoke	
	AOR (95% CI)*	p-value[#]	AOR (95% CI)*	p-value[#]	AOR (95% CI)*	p-value[#]
Age group						
18 to 44	Ref	0.30	Ref	0.14	Ref	0.72
45 or older	0.84 (0.61-1.17)		1.24 (0.93-1.66)		1.04 (0.84-1.28)	
Gender						
Male	Ref	0.90	Ref	0.001	Ref	0.82
Female	0.98 (0.69-1.39)		0.60 (0.44-0.82)		1.03 (0.83-1.27)	
Educational level						
Secondary or below	Ref	<0.001	Ref	<0.001	Ref	0.002
Above secondary	1.74 (1.33-2.28)		1.74 (1.38-2.18)		1.29 (1.09-1.51)	
Occupation						
Unemployed/housewife	Ref	0.63	Ref	0.90	Ref	0.27
Employed	1.12 (0.81-1.55)		1.04 (0.78-1.37)		1.06 (0.87-1.30)	
Retired	1.77 (0.68-4.63)		1.39 (0.58-3.33)		1.20 (0.96-2.09)	
Student	1.02 (0.62-1.68)		1.01 (0.66-1.54)		0.81 (0.61-1.09)	
Monthly income						
< 1450 NIS	Ref	0.61	Ref	0.93	Ref	0.14
≥ 1450 NIS	0.91 (0.65-1.29)		099 (0.74-131)		0.85 (0.69-1.05)	
Marital status						
Single	Ref	0.06	Ref	0.23	Ref	0.36
Married	1.20 (0.88-1.64)		1.09 (0.84-1.42)		1.12 (0.92-1.35)	
Divorced/Widowed	0.66 (0.36-1.20)		0.71 (0.42-1.22)		0.93 (0.60-1.44)	
Residency						
Gaza Strip	Ref	0.15	Ref	0.038	Ref	0.011
WBJ	1.26 (0.91-1.74)		1.33 (1.02-1.75)		1.29 (1.06-1.56)	
Having a chronic disease						
No	Ref	0.39	Ref	0.37	Ref	0.87
Yes	0.87 (0.63-1.20)		0.88 (0.67-1.16)		1.02 (0.83-1.35)	
Knowing someone with cancer						
No	Ref	0.21	Ref	0.60	Ref	0.037
Yes	1.17 (0.92-1.49)		1.06 (0.86-1.30)		1.17 (1.01-1.36)	
Ever smoked cigarettes and/or shisha						
No	Ref	<0.001	Ref	<0.001	Ref	0.001
Yes	0.54 (0.40-0.75)		0.55 (0.42-0.74)		0.71 (0.59-0.86)	
Site of data collection						
Public Spaces	Ref	0.007	Ref	0.11	Ref	0.054
Hospitals	1.52 (1.14-2.01)		1.30 (1.01-1.66)		1.11 (0.94-1.32)	
Primary healthcare centers	1.47 (1.05-2.05)		1.07 (0.81-1.39)		1.29 (1.05-1.58)	

AOR= adjusted odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.
*Adjusted for age-group, gender, educational level, occupation, monthly income, marital status, residency, having a chronic disease, knowing someone with cancer, smoking history, and site of data collection.
#p-value of likelihood ratio test.

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Supplementary table 5: Multivariable logistic regression analyzing factors associated with the recognition of other risk factors.

Characteristic	Exposure to chemicals		Exposure to radiation		Air pollution	
	AOR (95% CI)*	p-value[#]	AOR (95% CI)*	p-value[#]	AOR (95% CI)*	p-value[#]
Age group						
18 to 44	Ref	0.13	Ref	0.003	Ref	0.25
45 or older	1.17 (0.95-1.44)		1.38 (1.11-1.70)		1.13 (0.92-1.40)	
Gender						
Male	Ref	0.35	Ref	0.60	Ref	0.88
Female	0.91 (0.74-1.11)		0.95 (0.77-1.17)		0.98 (0.80-1.21)	
Educational level						
Secondary or below	Ref	0.004	Ref	<0.001	Ref	0.08
Above secondary	1.26 (1.08-1.48)		1.47 (1.26-1.73)		1.16 (0.98-1.36)	
Occupation						
Unemployed/housewife	Ref	0.46	Ref	0.013	Ref	0.49
Employed	0.85 (0.70-1.04)		1.20 (0.99-1.46)		1.03 (0.84-1.26)	
Retired	0.88 (0.51-1.52)		2.64 (1.24-5.60)		1.11 (0.63-1.95)	
Student	0.68 (0.65-1.16)		1.29 (0.97-1.73)		0.83 (0.62-1.11)	
Monthly income						
< 1450 NIS	Ref	0.11	Ref	0.013	Ref	0.29
≥ 1450 NIS	1.18 (0.96-1.46)		1.30 (1.06-1.60)		1.12 (0.91-1.37)	
Marital status						
Single	Ref	0.54	Ref	0.035	Ref	0.32
Married	0.92 (0.77-1.11)		1.27 (1.06-1.52)		0.89 (0.73-1.07)	
Divorced/Widowed	0.81 (0.53-1.23)		1.10 (0.72-1.68)		0.75 (0.49-1.16)	
Residency						
Gaza Strip	Ref	0.40	Ref	0.14	Ref	<0.001
WBJ	1.09 (0.89-1.32)		0.86 (0.71-1.05)		1.47 (1.21-1.78)	
Having a chronic disease						
No	Ref	0.71	Ref	0.89	Ref	0.35
Yes	1.04 (0.74-1.28)		1.02 (0.83-1.25)		1.11 (0.89-1.37)	
Knowing someone with cancer						
No	Ref	<0.001	Ref	<0.001	Ref	<0.001
Yes	1.72 (1.48-1.99)		1.52 (1.32-1.76)		1.51 (1.31-1.76)	
Ever smoked cigarettes and/or shisha						
No	Ref	0.76	Ref	0.23	Ref	0.48
Yes	0.97 (0.80-1.18)		0.89 (0.73-1.08)		1.07 (0.88-1.31)	
Site of data collection						
Public Spaces	Ref	<0.001	Ref	0.35	Ref	<0.001
Hospitals	1.77 (1.49-2.10)		1.05 (0.89-1.25)		1.41 (1.19-1.68)	
Primary healthcare centers	2.38 (1.94-2.94)		1.16 (0.95-1.41)		1.77 (1.44-2.18)	

AOR= adjusted odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

*Adjusted for age-group, gender, educational level, occupation, monthly income, marital status, residency, having a chronic disease, knowing someone with cancer, smoking history, and site of data collection.

#p-value of likelihood ratio test.

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Supplementary table 5: Multivariable logistic regression analyzing factors associated with the recognition of other risk factors (Ctd).

Characteristic	Having a previous history of lung disease		Having a previous history of cancer		Having had treatment for any cancer in the past		Having a close relative with lung cancer	
	AOR (95% CI)*	p-value#	AOR (95% CI)*	p-value#	AOR (95% CI)*	p-value#	AOR (95% CI)*	p-value#
Age group								
18 to 44	Ref	0.13	Ref	0.44	Ref	0.72	Ref	0.08
45 or older	1.14 (0.96-1.36)		1.07 (0.90-1.26)		1.03 (0.88-1.21)		1.16 (0.98-1.36)	
Gender								
Male	Ref	0.51	Ref	0.83	Ref	0.63	Ref	0.002
Female	1.06 (0.89-1.26)		0.98 (0.83-1.16)		1.04 (0.88-1.23)		1.30 (1.10-1.54)	
Educational level								
Secondary or below	Ref	0.13	Ref	0.34	Ref	0.14	Ref	0.09
Above secondary	1.11 (0.97-1.27)		0.94 (0.82-1.07)		1.10 (0.97-1.25)		1.12 (0.98-1.27)	
Occupation								
Unemployed/housewife	Ref	0.030	Ref	0.20	Ref	0.31	Ref	0.002
Employed	1.26 (1.07-1.49)		1.04 (0.88-1.22)		1.01 (0.87-1.19)		1.21 (1.04-1.42)	
Retired	1.41 (0.89-2.24)		1.60 (1.02-2.49)		0.99 (0.65-1.49)		1.22 (0.81-1.84)	
Student	1.03 (0.80-1.31)		0.97 (0.76-1.23)		1.24 (0.98-1.57)		0.81 (0.64-1.03)	
Monthly income								
< 1450 NIS	Ref	0.29	Ref	0.40	Ref	0.99	Ref	0.82
≥ 1450 NIS	0.91 (0.76-1.09)		1.08 (0.91-1.27)		1.00 (0.85-1.18)		1.02 (0.86-1.21)	
Marital status								
Single	Ref	0.93	Ref	0.63	Ref	0.36	Ref	0.14
Married	1.01 (0.86-1.19)		0.98 (0.84-1.14)		1.11 (0.74-1.02)		0.86 (0.74-1.00)	
Divorced/Widowed	0.95 (0.66-1.38)		1.15 (0.80-1.64)		1.01 (0.71-1.44)		0.86 (0.61-1.22)	
Residency								
Gaza Strip	Ref	0.77	Ref	0.86	Ref	0.73	Ref	0.053
WBJ	0.98 (0.83-1.15)		1.01 (0.87-1.19)		0.97 (0.83-1.14)		1.17 (1.00-1.36)	
Having a chronic disease								
No	Ref	0.85	Ref	0.91	Ref	0.08	Ref	0.84
Yes	1.02 (0.85-1.21)		1.01 (0.86-1.19)		0.86 (0.74-1.02)		1.02 (0.86-1.19)	
Knowing someone with cancer								
No	Ref	0.06	Ref	<0.001	Ref	<0.001	Ref	0.10
Yes	1.13 (1.00-1.28)		1.47 (031-1.66)		1.30 (1.15-1.46)		1.11 (0.98-1.24)	
Ever smoked cigarettes and/or shisha								
No	Ref	0.28	Ref	0.12	Ref	0.84	Ref	0.28
Yes	0.91 (0.77-1.08)		0.88 (0.75-1.03)		1.02 (0.87-1.19)		0.92 (0.78-1.07)	
Site of data collection								
Public Spaces	Ref	<0.001	Ref	<0.001	Ref	<0.001	Ref	0.23
Hospitals	1.30 (1.45-1.50)		1.40 (1.22-1.61)		1.16 (1.01-1.33)		1.08 (0.94-1.24)	
Primary healthcare centers	1.52 (1.28-1.80)		1.86 (1.58-2.19)		1.70 (1.45-1.99)		1.14 (0.98-1.34)	

AOR= adjusted odds ratio, CI= confidence interval, WBJ= West Bank and Jerusalem.

*Adjusted for age-group, gender, educational level, occupation, monthly income, marital status, residency, having a chronic disease, knowing someone with cancer, smoking history, and site of data collection.

#p-value of likelihood ratio test.

4

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			**4**
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	N/A
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7-8
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(*e*) Describe any sensitivity analyses	N/A
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-9
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12-17
		(*b*) Report category boundaries when continuous variables were categorized	N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	21
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	21
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	22

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.