Meningitis and seasonal influenza vaccination coverage among military personnel in central Saudi Arabia

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ABSTRACT

الأهداف: تحديد معدل تغطية التطعيمات لكل من مرضى التهاب السحايا والأنفلونزا بين أفراد القوات المسلحة في المنطقة العسكرية الوسطى، بالإضافة إلى تحديد العوامل الاجتماعية الديموغرافية التي تؤثر على نسبة التطعيم.

الطريقة: شملت هذه الدراسة المقطعية الوصفية 2286 فرداً من مختلف القوات المسلحة ومختلف الرتب العسكرية في المنطقة العسكرية الوسطى، الرياض، المملكة العربية السعودية. وقد تم اختيار عينة الدراسة بطريقة العينة العشوائية الطبقية متعددة المراحل، وتم جمع البيانات عن طريق الاستبيان الذاتي والذي تم تصميمه خصيصاً للمسح الوطني الصحي العسكري، وأضيف إلى هذا الاستبيان فقرة خاصة بتقييم حالة التطعيم. وقد تم جمع البيانات خلال الفترة من مايو إلى أغسطس 2009م.

النتائج: أشارت النتائج إلى أن معدل الاستجابة قد وصل إلى 97.6%، وكانت نسبة التغطية بلقاح التهاب السحايا (51.7%) أعلى من الأنفلونزا (17.8%). وقد أظهرت نسبة كبيرة من الأفراد قلة الوعي بحالة التطعيم لديهم. وكانت نسبة التطعيم أعلى في القوات البرية مقارنة بالقوات المسلحة الأخرى، وزادت هذه النسبة مع زيادة سنوات التعليم وانخفاض مؤشر الازدحام.

خاتمة: أثبتت الدراسة مدى انخفاض معدل تغطية التطعيمات بين أفراد القوات المسلحة في المنطقة الوسطى بالمملكة العربية السعودية، وخصوصاً نسبة التغطية بلقاح الأنفلونزا، كما أكدت الدراسة قلة وعي الأفراد بحالة التطعيم لديهم. ونوصي بعمل برنامج شامل للتطعيم يتضمن تعزيز الوعي حول الأمراض التي يمكن الوقاية منها باللقاحات، مع عمل تغيير في السياسات الصحية بهدف جعل التطعيم ضد الالتهاب السحائي والأنفلونزا إجبارياً بين صفوف القوات المسلحة.

Objectives: To determine the meningitis and influenza vaccination coverage rates among Saudi military personnel in Riyadh (Central Military Region [CMR]), Kingdom of Saudi Arabia, (KSA) and the socio-demographic factors that influence vaccination.

Methods: This cross-sectional descriptive study was carried out on a sample of 2286 military personnel from different army forces and different military ranks in CMR in KSA selected by a 2-stage stratified random sampling technique. A self-administered questionnaire designed for the National Military Health Survey was used with a section added for assessment of vaccination status. Data collection was carried out from May to August 2009.

Results: The response rate was 97.6%. The vaccination coverage was higher for meningitis (51.7%) compared with influenza (17.8%). A high percentage lacked awareness of their vaccination status. Vaccination rates were higher in the Land Forces, and increased with more years of education, and lower crowding index.

Conclusion: The proportion of vaccination coverage among military personnel in CMR of KSA is low, especially for influenza, along with their awareness of their vaccination status. A vaccination program that includes awareness promotion of vaccine-preventable diseases is recommended, with changes in the policies to mandate vaccination against meningitis and influenza.

Saudi Med J 2011; Vol. 32 (2): 159-165

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Received 4th October 2010. Accepted 22nd December 2010.

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Infectious diseases have had a major impact on military campaigns throughout history.[1] Nowadays, infectious diseases continue to pose a substantial threat to the operational capacity of military forces and constitute

one of the largest components of the morbidity category known as disease and non-battle injury.[2-4] A number of outbreaks of pertussis[5] and mumps[6] were recently reported among militaries in France and Luxembourg. Many reasons have been proposed for this higher risk among militaries. Overcrowding is one of these factors, as recruits continue to train and live in groups in crowded conditions.[7] Also, the increasing use of biological weapons poses a new threat.[8,9] Another factor is the exposure of deployed military personnel in missions, either peacekeeping or combatant, to new pathogenic agents with no previous immunity against them.[10-12]

Vaccination is the primary and first line of prevention against many infectious diseases. Evidence-based data provide solid information regarding vaccination programs benefits and cost-effectiveness.[13,14] However, although basic vaccination programs are successful and achieve high coverage rates in most countries, the situation is different for adult vaccination, where the coverage rates range from 26-65% depending on the vaccine and the target population,[15] and were often judged to be inadequate.[16] Many factors have been postulated to underlie the low rates of adult vaccination coverage as the informational prerequisites for government decision making,[17] establishment and dissemination of disease burden, cost-effectiveness analysis, assurance of adequate vaccine supplies, as well as public perceptions, and the opinion of the medical community.[18] Additionally, fear from the side effects of vaccines, combined with the witnessed drop in most vaccine-preventable infectious disease incidences could add to reluctance to be vaccinated. In the military personnel, Porter et al[19] found that the only factor that determined acceptance or refusal of vaccination was the perception of vaccine safety. Thus, improving vaccination coverage rates among adults, especially those at high risk remains a serious public health challenge.[20] Vaccines have served as a key mode of preventing infections among military forces. This was started in America, since General George Washington ordered the systematic variolation of the Continental Army to protect it from smallpox.[21] Due to higher risk, members of the military must receive vaccinations beyond what the typical man, woman, and child receive, and may need to receive vaccines for uncommon illnesses.[11] To control and eliminate vaccine-preventable diseases among military personnel, it is important to know the vaccination coverage among them. Despite the urgent need for this information, there is a lack of such studies in the Kingdom of Saudi Arabia (KSA). The objective of the study was to determine the meningitis and influenza vaccination coverage rates among military personnel in Riyadh (Central Military Region[CMR]), KSA, and the socio-demographic factors that influence vaccination to establish strategies for comprehensive coverage.

Methods. A cross-sectional descriptive design was used in this study carried out on a sample of military posts of different army forces in the CMR in KSA. The sampling population consisted of all military staff from different army forces and different military ranks in the CMR, with no inclusion or exclusion criteria. A two-stage stratified random sampling technique was utilized. Four strata were identified according to army forces, which were; Land Forces, Air Forces, Navy, and Air Defense. Within each of these strata, military personnel were stratified into officers and soldiers. In the first stage of sampling, military posts were randomly selected from each of the 4 army forces. In the second stage, a systematic random sample was recruited from each of the 2 strata, officers and soldiers, according to the required sample size, which was calculated as a part of the sampling plan for the National Military Heath Survey. The sample size for Riyadh region was 2286, considering a dropout rate of 10%. This was divided equally among the 4 forces, except for the air defense, which had a smaller sample size. Thirty percent of the sample consisted of officers. A self-administered questionnaire was designed for the National Military Heath Survey. The present study utilized the personal characteristics section of this questionnaire, and added to it a section for assessment of vaccination status of respondents. The response for each vaccine intake was "yes," "no," or "do not remember." After securing official permission to conduct the study from the Medical Services Department (MSD) review board, the sampling process was started. The data collection tool was reviewed by experts, pilot-tested, and finalized according to the results of the pilot study. A field coordinator visited the sites and prepared the sample for the data collection team the day before. The field team visited the site, explained the purpose of the study to participants, and obtained their written informed consent to participate. Upon acceptance, the participant was handed the questionnaire, and asked to fill it out. The field team was present all the time to clarify any queries. The completed forms were then collected, verified for completion, and sent the same day to the data management center. Data collection was carried out from May to August 2009.

All principles of ethics in research were applied. Written informed consent was obtained, and the participants were informed of their rights to refuse or withdraw with no reason or consequences. Confidentiality of the information obtained was secured. Participants who needed medical help or advice were managed professionally either by direct care, or through proper referral.

Data entry and analysis were carried out using the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) version 14. Chi-square test was used to assess the statistical significance in comparisons of categorical data. Binary logistic regression analysis was carried out to identify the independent predictors of vaccination. The level of statistical significance was set at $p<0.05$.

Results. Out of 2286 filled forms, 2230 were completely filled out, giving a response rate of 97.6%. The sample mean age was 36.3 ± 7.5 years, and their mean duration of military service was 14.9 ± 7.8 years (**Table 1**). Most were married. Their income was mostly reported to be sufficient, and approximately one-third were saving. Approximately one-fourth had a crowding index of 2 persons per room or higher. Concerning vaccination coverage, **Table 2** demonstrates that slightly more than half of the sample (51.7%) remembered they had the meningitis vaccine. As for influenza vaccine, only less than one-fifth (17.8%) remembered having had it, and approximately half did not remember. Even with the exclusion of those who do not remember, only 35.7% had the influenza vaccine. The comparison of the participants who remembered having received the meningitis vaccine with those who remembered not having received it revealed a number of statistically significant differences (**Table 3**) among Army Forces ($p=0.001$), their rank ($p<0.001$), educational level ($p<0.001$), income ($p=0.001$), and crowding index ($p<0.001$). It is evident that the percentages of those who reported having been vaccinated had an increasing trend with higher level of education, higher income, and lower crowding index. They were also higher in Land Forces and Air Defense, and among officers compared to soldiers. No trend with age could be revealed. Concerning the comparison of those who remembered having received seasonal influenza vaccine with those who remembered not having received it, the statistically significant differences were related to Army Forces ($p=0.001$), rank ($p=0.025$), and educational level ($p=0.043$). As **Table 4** demonstrates officers, and those in the Land Forces had the higher rates of influenza vaccination. As for education, there was only a statistically significant increasing trend, but with no significant differences among various levels of education. When logistic regression was used for adjustment of the odds ratios, the rank did not resist adjustment (**Table 5**). On the other hand, the number of educational years and the army type had statistically significant relations with meningitis and influenza vaccination. It is evident that the vaccinated subjects had higher odds of having more years in education, and of not being in the Air Force or Navy, namely, higher odds of being in the Land Forces. Additionally, the odds of lower crowding index were significantly higher among those who had meningitis vaccination.

Table 1 - Socio-demographic characteristics of military staff in the study sample (N=2230).

Characteristics	n	(%)
Army Forces		
Air Forces	659	(29.6)
Land Forces	656	(29.4)
Navy	595	(26.7)
Air Defense	320	(14.3)
Rank category		
Officers	635	(28.5)
Soldiers	1595	(71.5)
Age, mean ± SD	36.3 ± 7.5	
Educational years, mean ± SD	12.9 ± 3.2	
Years in military service, mean ± SD	14.9 ± 7.8	
Marital status		
Single	259	(11.6)
Married	1897	(85.1)
Divorced/widow	7	(0.3)
Missing	67	(3.0)
Crowding index (person/room)		
<1	349	(15.7)
1-<2	1331	(59.7)
≥2	550	(24.7)
Income		
Saving	751	(33.7)
Just sufficient	948	(42.5)
Insufficient	465	(20.9)
Refused to answer	66	(3.0)

Table 2 - History of meningitis and influenza vaccinations among military staff in the study sample (N=2230).

Vaccinations obtained	Total		Those who remember
	n	(%)	
Meningitis			
Yes	1153	(51.7)	(83.4)
No	230	(10.3)	(16.6)
Do not remember	847	(38.0)	
Influenza			
Yes	396	(17.8)	(35.7)
No	712	(31.9)	(64.3)
Do not remember	1122	(50.3)	

Discussion. To control and eliminate vaccine-preventable diseases it is important to know the vaccination coverage and reasons for non-vaccination. The objective of this study was to measure the vaccination coverage among military staff in the CMR in KSA. The results showed a low level of vaccination coverage among them. In addition, there was a clear lack of awareness of their own vaccination status in approximately half of the participants for the studied

Table 3 - Comparison of military staff with and without meningitis vaccination according to socio-demographic characteristics.

Characteristics	Meningitis vaccination				95% confidence intervals for odds ratio	*P*-value (χ^2 test)
	Yes		No			
	n (%)				Lower limit< OR< upper limit	
Age						
<30	203	(79.6)	52	(20.4)		
30-<40	528	(86.3)	84	(13.7)	0.42<0.62<0.93	
40-<50	391	(81.6)	88	(18.4)	0.59<0.88<1.31	
≥50	31	(83.8)	6	(16.2)	0.27<0.76<2.03	0.061
Army forces						
Navy	273	(78.2)	76	(21.8)		
Air Forces	322	(80.9)	76	(19.1)	0.58<0.85<1.23	
Land Forces	405	(87.9	56	(12.1)	0.33<0.50<0.74	
Air Defense	153	(87.4)	22	(12.6)	0.30<0.52<0.89	0.001
Rank category						
Soldiers	723	(78.9)	193	(21.1)		
Officers	430	(92.1)	37	(7.9)	0.22<0.32<0.47	<0.001
Highest educational attainment						
Basic	45	(69.2)	20	(30.8)		
Intermediate/secondary	672	(79.7)	171	(20.3)	0.32<0.57<1.03	
University	436	(91.8)	39	(8.2)	0.10<0.20<0.39	<0.001
Income						
Insufficient	194	(76.1)	61	(23.9)		
Just sufficient	500	(84.3)	93	(15.7)	0.41<0.59<0.86	
Saving	436	(86.7)	67	(13.3)	0.33<0.49<0.73	
Refused to answer	23	(71.9)	9	(28.1)	0.50<1.24<3.02	0.001
Crowding index (person/room)						
<1	364	(86.7)	56	(13.3)		
1-<2	540	(84.8)	97	(15.2)	0.81<1.17<1.69	
≥2	249	(76.4)	77	(23.6)	1.35<2.01<2.99	<0.001

vaccines. The rates varied by rank and by Army Forces. The study was carried out through self-reporting using a short questionnaire completed on-site, which explains the high response rate. Thus, the survey data depended only on participant's recall, and were not validated by medical records or official documentation. This technique was used by Arteaga et al,[22] and it showed good predictive values when compared to serology testing. Meanwhile, Murphy et al[23] reported some discrepancies between self-reporting and recorded vaccination history in the recall of related side effects. Although the self-reporting technique might jeopardize the validity of our data, the exclusion of the "do not remember" category from the total still yields low rates of vaccination coverage, particularly for the seasonal influenza. Concerning the influenza vaccine, it is recommended for military personnel in most countries.[14,24] According to our study findings, only less than one-fifth of the respondents remembered having it. This is a very low proportion given the double risk our study participants are exposed to, namely, workplace risk as militaries, and the high risk of exposure during Umra and Hajj. The finding could not be totally attributed to lack of awareness or knowledge, as low rates were also previously documented among healthcare workers in KSA.[25] From another perspective, the effect of influenza on productivity warrants full coverage vaccination as a cost-effective primary prevention measure in workplaces as reported by Abbas et al[13] who showed a net saving of direct medical costs of approximately 28 US$ for each vaccinated worker.

The current study revealed a significant difference among various army forces regarding vaccination coverage. The finding is in agreement with Steele et al[26] who similarly demonstrated a wide variation of immunization coverage. This might be related to differential immunization accessibility, or lack of information. The higher coverage in land forces might be explained by their potential higher risk of exposure to meningitis and influenza, as they are more prone to assigned missions during Hajji and Umra, in addition to personal fulfillment of these religious rituals. In these situations, people come from various countries of the world with potential carriage of different strains of infectious microorganisms. For instance, Kilic et al[27] reported an outbreak of *Neisseria meningitidis* serogroup W135 meningococcal infection among soldiers in Turkey, a strain that was first isolated in KSA, and was

Table 4 - Comparison of military staff with and without influenza vaccination according to socio-demographic characteristics.

Characteristics	Influenza vaccination				95% confidence intervals for OR	*P*-value (X^2 test)
	Yes		No		Lower limit< OR< upper limit	
	n (%)					
Age						
<30	66	(33.5)	131	(66.5)		
30-<40	174	(36.0)	309	(64.0)	0.62<0.89<1.29	
40-<50	143	(36.1)	253	(63.9)	0.61<0.89<1.30	
≥50	13	(40.6)	19	(59.4)	0.32<0.74<1.69	0.849
Army forces						
Air Defense	35	(25.5)	102	(74.5)		
Navy	65	(26.4)	181	(73.6)	0.58<0.96<1.58	
Air Forces	115	(32.8)	236	(67.2)	0.44<0.70<1.12	
Land Forces	181	(48.4)	193	(51.6)	0.23<0.37<0.58	<0.001
Rank category						
Soldiers	242	(33.4)	483	(66.6)		
Officers	154	(40.2)	229	(59.8)	0.57<0.75<0.97	0.025
Highest educational attainment						
Basic	15	(28.3)	38	(71.7)		
Intermediate/secondary	228	(34.2)	438	(65.8)	0.39<0.76<1.46	
University	153	(39.3)	236	(60.7)	0.31<0.61<1.19	0.043*
Income						
Insufficient	66	(31.0)	147	(69.0)		
Just sufficient	171	(35.8)	306	(64.2)	0.56<0.80<1.15	
Saving	151	(38.1)	240	(61.4)	0.49<0.71<1.03	
Refused to answer	8	(29.6)	19	(70.4)	0.42<1.07<2.81	0.067*
Crowding index (person/room)*						
<1	128	(37.5)	213	(62.5)		
1-<2	172	(34.6)	325	(65.4)	0.84<1.14<1.53	
≥2	96	(35.6)	174	(64.4)	0.77<1.09<1.54	0.684

*X^2 for trend, OR - odds ratio

Table 5 - Adjusted odds ratios (OR) for some socio-demographic characteristics in relation to meningitis and influenza vaccination.

Characteristics	ß coefficient	Standard error	Wald	OR	95% confidence intervals for OR		*P*-value
					Lower	Upper	
Meningitis							
Rank: reference soldier	0.464	0.247	3.541	1.591	0.981	2.580	0.060
Years of education	0.117	0.032	13.200	1.124	1.055	1.197	<0.001
Crowding index	-0.221	0.094	5.554	0.802	0.667	0.963	0.018
Army: reference Air Force, Navy	-0.659	0.158	17.470	0.517	0.380	0.705	<0.001
Influenza							
Years of education	0.048	0.019	6.391	1.050	1.011	1.090	0.011
Army: reference Air Force, Navy	-0.526	0.127	17.101	0.591	0.460	0.758	<0.001

Variables entered in logistic regression: age, years of education, income, crowding index, military rank, years of service, army (land forces versus other armies), OR - odds ratio

responsible for the worldwide outbreak among Hajj pilgrims and their contacts in 2000.

Therefore, meningitis vaccine is mandatory according to local regulations and the National Center for Disease Control recommendations,[28,29] which should have increased meningitis vaccination to approach total coverage. However, the rate of meningitis vaccine coverage revealed in our study is far below full coverage, a situation that mandates that this vaccine is obligatory among military personnel. In line with this, the Advisory Committee on Immunization Practices (ACIP) and other authorities[29-31] now recommend the quadrivalent conjugate vaccine for anyone at increased risk of the disease, such as military staff. This should be started soon, as it took the Italian Army 3 years to achieve total meningitis vaccine coverage since it decided to make

it compulsory by law starting January 1987.[32] The present study also revealed that officers had significantly higher coverage for all vaccines under study compared to soldiers. This rather expected finding might be attributed to several factors, such as differences in the level of education and income with repercussion on health awareness and health seeking behavior. In fact, after adjustment for confounders, the effect of rank was obviated by educational years and crowding index. The implication is that more efforts are needed to improve the health awareness of soldiers. In this respect, Joshi and Bala[33] highlighted that military preventive health services must be efficient, easily accessible, and free of charge to all eligible personnel.

In the KSA situation, the MSD of the Ministry of Defense and Aviation (MODA) provides the infrastructure and resources to achieve high vaccination coverage for military staff. This would be expected to give a thrust to preventive programs, especially vaccination. Therefore, the low coverage revealed could reflect low awareness of the importance of vaccination, or a reluctant attitude towards it. Added to this, is the lack of strict regulations for enforcement of vaccination. Given the seriousness of many vaccine-preventable diseases, and the potentially higher risk of exposure to these diseases, mandatory programs are preferable, since voluntary programs generally prove to be less successful. Therefore, if political leaders were to make immunization a priority, coverage rates would consequently improve.[34]

We conclude that the rate of vaccination coverage among military personnel in the CMR of KSA is low, as is their awareness of their vaccination status. Although the study findings are based on self-reporting, not substantiated by records or serological testing, which is the main study limitation, they still provide an indication of low coverage and a need for prompt intervention. Therefore, a vaccination program that includes awareness promotion regarding vaccine-preventable diseases is recommended. Also, changes in the policies to mandate vaccination against meningitis and influenza among military personnel and recruits are needed. Further research is needed to investigate the causes underlying the low vaccination coverage among militaries.

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