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Full Length Research Paper

Prevalence study of cytomegalovirus (CMV) infection among foreign manpower in Jeddah Saudi Arabia

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Human cytomegalovirus (HCMV) is a species-specific DNA virus of the Herpetoviridae family. Cytomegalovirus (CMV) is more widespread in developing countries and in areas of low socio-economic conditions. It causes high morbidity and mortality. After primary infection CMV is not eradicated but establishes life-long infection in its host. CMV dispersed and become dormant or latent in multiple end organs, and can later be reactivated by a number of different stimuli, including immunosuppresion and inflammation. To determine CMV prevalence in a sample of the foreign manpower population in Jeddah region, Saudi Arabia, we tested serum samples for CMV-specific immunoglobulin G from participants aged 20 to 60 years (n = 514) by enzyme linked immunosorbent assay (ELISA). The prevalence of CMV infection was 80.7% in studied population. CMV prevalence differed significantly by sex ($p<0.05$). The prevalence of cytomegalovirus was higher significantly in females (86.8%) than in males (75.00%). CMV seroprevalence increased gradually with age, ranging from 53.8% in 20–24 year olds to 95.2% in those aged 55 to 60 years. CMV seroprevalence differed significantly ($p<0.05$) by nationality and/or ethnicity as follows: 66.7% in Indian, 78.7% in Egyptian, 76.7% in Yemeni, 87.8% in Sudani, 82.7% in Pakistani, 83.6% in Bangladeshi, to 88.9% in Ethiopian. The seroprevalence of cytomegalovirus among the African population (85.1%) varied significantly ($p<0.05$) from Asian population (77.5%). The finding that high levels of CMV exposure occur in the first years of life suggests that for a universal vaccination program to have maximal impact, the vaccine would need to be delivered to infants and have a long duration of protective efficacy. This is the first seroprevalence looking at cytomegalovirus in the foreign manpower community in Jeddah region, Saudi Arabia. This study provides valuable information that can be used to examine the incidence of infection in the community and help focus the administration of a future CMV vaccine to appropriate target populations.

Key words: Cytomegalovirus (CMV), virus, seroprevalence, enzyme linked immunosorbent assay (ELISA), immunoglobulin G (IgG).

INTRODUCTION

Cytomegalovirus (CMV) infections are endemic worldwide. Infections with CMV are usually asymptomatic in healthy individuals. However, they often result in life threatening health conditions in individuals with impaired or underdeveloped immune systems including organ transplant recipients; human immunodeficiency virus (HIV) infected individuals, and the fetus or newborn infants. In transplant recipients, CMV is the single most important pathogen due to its frequent direct and indirect effects on both morbidity and mortality (Fowler et al., 2003). For HIV/AIDS patients, CMV reactivations and reinfections are common problems. In newborns CMV is

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a leading cause of congenital infection worldwide (Mussi-Pinhata et al., 1998). CMV initially enters the body through the epithelium of the upper alimentary, respiratory, or genitourinary tracts.

However, the initial infection of epithelial cells is not essential, as demonstrated by infections from blood transfusions and organ transplantation. CMV is spread through the body with the aid of leukocytes and vascular endothelial cells (Halpern et al., 2004). Dissemination of CMV through the blood is typically followed by infection of the ductal epithelial cells. CMV spreads through the body quickly into many sites. Historical in-vitro studies characterize CMV as a slowly replicating virus, but in a recent study based on changes in viral load in humans, CMV has been shown to replicate quickly with a doubling time of approximately one day during active infection (Gerna et al., 2004). CMV infects a wide range of tissues and cell types: it has been found in salivary glands, lung, liver, pancreas, kidney, ear, eye, placenta, alimentary tract, heart, ovaries, pituitary, brain, skin, thyroid, esophagus, prostate, testes, and adrenals (Reddehase et al., 2002).

In the vast majority of healthy individuals the immune system quickly reaches homeostasis with CMV. While the immune system of healthy individuals is usually able to prevent CMV from producing clinical manifestations, the immune system very rarely completely eliminates CMV from the body - the viral genome remains in a latent stage waiting for reactivation. While the latent stage of CMV infection has been researched extensively, the identity of cell types that harbor latent CMV, the ranges of genes expressed during latency, and the mechanisms of reactivation continue to be controversial (Jarvis and Nelson, 2002).

A crucial part of the immune system defense against CMV is the development of CMV specific antibodies. Antibodies bind to CMV, thereby inhibiting its ability to infect new cells and marking it for removal from the body. The first type of antibody to develop in response to CMV is IgM, which develops within a few days following primary infection. While CMV IgM remains detectable for six to nine months, medium to high levels of CMV IgM can be detected during the first three months of a primary infection. IgM can also be detected during some secondary infections, both reactivation and reinfection, and is therefore not a valid marker of primary infection. The second antibody type to respond to CMV is IgG. This antibody develops within 1 to 2 weeks after infection and, once developed, can be detected throughout life. Consequently, IgG is commonly used and widely accepted measure of previous CMV infection (Drew, 1988).

CMV seropositivity rates are higher in females, older people, those of lower socioeconomic status (SES) and residents of developing countries. A recent study also shows a relationship between ethnicity and seroprevalence that is independent of factors such as SES. Worldwide, seroprevalence in adults in the general population varies from 40 to 90% (Dowd et al., 2009).

Tests for antibodies in an individual's serum are called serologic tests. If antibodies are not detected in the serum, the individual is seronegative. For IgG, this is commonly interpreted to mean that the individual's immune system has never encountered the virus and they have never been infected with CMV. Individuals are called seropositive if antibody to the virus is detectable in their blood. This means that the individuals have been previously infected with CMV. If upon an individual's first CMV IgG test they are seronegative and on a later test are seropositive, the individual is said to have undergone seroconversion, indicating the occurrence of a primary infection.

The aim of this study was a prevalence of infected CMV in worker population in Jeddah region, Saudi Arabia. In addition, find out the relationship of our result with age, gender and ethnicity.

MATERIALS AND METHODS

Serum samples collection

A total of 514 serum samples were tested for CMV seroprevalence using enzyme linked immunosorbent assay (ELISA). Samples were collected from 4 diagnostic laboratories throughout Jeddah, including: the Medical Laboratory of Ghulail Dispensary, Medical Laboratory of Badr Adeen Dispensary, Medical laboratory of AL-Quds dispensary and Medical laboratory of University street hospital. These laboratories supplied remnant sera from samples that had been submitted for serological testing and would otherwise have been discarded. Sera from subjects who were known to be infected with human immunodeficiency virus, hepatitis B virus and hepatitis C virus were excluded. Sera were identified at the referring laboratory by the sex of the subject, age or date of birth, date of collection, and nationality. The samples were coded by date of collection, nationality/territory of origin, sample number and referring laboratory. All serum samples were stored at -20°C until use.

Study population

Serum samples were collected from foreign workers between 20 and 60 years of age and stratified into the following age groups: 20 to 24, 25 to 29, 30 to 34, 35 to 39, 40 to 44, 45 to 49, 50 to 54 and. 55 to 60, Serum samples were not available for less than 20 year of age. Approximately equal numbers of males and females were tested. Also, approximately equal numbers of seven nationalities including: Egyptian, Yemeni, Sudan, Pakistani, Indian, Bangladesh and Ethiopian were tested. Prevalence was calculated separately for each age group, for each nationality, for male and female separately, and for foreign workers as a whole. The CMV prevalence for the group aged 61 years and above was assumed to be the same as for the group aged 55 to 60 years. Sample sizes were calculated to achieve a 95% confidence interval (CI) of approximately ±5% for each age group.

Serological testing

Serum samples were tested for HCMV-specific immunoglobulin G

(IgG) using a HCMV IgG enzyme-linked immunosorbent assay (ELISA) technique using DRG kit (DRG International, Inc., USA).

Principle of the test

The antigen composed of partially purified and inactivated cytomegalovirus is bound to the solid phase (8-well strips). The specific immunoglobulin is bound to the antigen through incubation with diluted human serum. After washing to eliminate the proteins which have not reacted, incubation is performed with the conjugate, composed of human IgG monoclonal antibodies conjugated to horse radish peroxidase. The unbound conjugate is eliminated, and the peroxidase substrate added. The blue color which develops is proportional to the concentration of specific antibodies present in the serum sample. When the enzymatic reaction is interrupted by the addition of sulphuric acid solution, the yellow color, which develops, can be easily read by using a microplate reader (Wisdom, 1976).

Reagent preparation

All reagents should be allowed to reach room temperature (18 to 25°C) before use. Dilute 1 volume of wash buffer with 19 volume of distilled water. For example, dilute 50 ml of wash buffer into 950 ml distilled water to prepare 1000 ml of wash buffer which is stable for 1 month at 2 to 8°C. mixed well before use.

Sample and controls dilution

Prepare 1:40 dilution of test samples, negative control, positive control and calibrator by adding 5µl of the samples and controls to 195 µl of sample diluents and mixed well. Procedure is as in assay (ELISA) technique using DRG kit.

RESULTS

Calculation of the result

QUALITATIVE RESULTS

The CMV IgG Index of each determination was calculated by dividing the absorbance value of each sample by absorbance value of cut-off. Samples with CMV index less than 0.90 was sero-negative for IgG antibody to CMV, those with CMV index between 0.91 and 0.99 is equivocal and the samples should be repeated.

QUANTITATIVE RESULTS

For quantitative determination of anti-CMV IgG levels of positive specimens in IU/ml, the O.D of cut-off and positive calibrators are plotted on the Y-axis of a group against their corresponding anti-CMV IgG concentration of 0, 1, 2, 6, 18 IU/ml on the X-axis. The estimates of levels in patient sera are read off the graph using their individual O.D. values.

Interpretation of the results

QUALITATIVE RESULTS

The results were interpreted according to the manufacturer's instructions. Samples with CMV index less than 0.90 was seronegative for IgG antibody to CMV, those with CMV index between 0.91 and 0.99 is equivocal and the samples should be repeated. Samples with CMV index of 1.00 or greater was seropositive for IgG antibody to CMV.

QUANTITATIVE RESULT

The results were interpreted according to the manufacturer's instructions. when the anti-CMV IgG concentration in the sample is less than 0.8 IU/ml, the sample was no immune, those with anti-CMV IgG concentration is more than 1.2 IU/ml, the sample was immune. If the result is between the two values, in this case it is advisable to repeat the test in duplicate.

Statistical analysis

The percentages of individuals with positive, negative, and equivocal results were determined for each age group and sex. SPSS program version 15 was used for the analysis and comparison of sero-statuses among age groups, male and female and each nationality. Ninety-five-percent confidence intervals were calculated where appropriate, and *P* values of < 0.05 were considered statistically significant.

Demographic characteristics of the studied population

Serum samples according to sex divided to two groups' males (51.4%) and female (48.6%) with their ages varied from 20-60 years old. Serum samples were stratified according to age into the following groups: 20 to 24 (12.6%), 25 to 29 (12.6%), 30 to 34 (12.8%), 35 to 39 (12.8%), 40 to 44 (12.4%), 45 to 49 (12.3%), 50 to 54 (12.3%) and 55 to 60 (12.1%) year. Serum samples were not available for less than 18 years of age. Serum samples according to nationality were divided to the following groups: Egyptian (14.6%), Yemen (14.2%), Sudan (14.4%), Pakistan (14.6%), Indian (14%), Bangladesh (14.2%) and Ethiopian (14%). According to race/ethnicity serum samples were divided to African (43%) and Asian (57%). Approximately equal numbers of males and females were tested. Also approximately equal numbers of each nationality and ages groups were tested. Prevalence of CMV- IgG in each group were tested using enzyme linked immunosorbent assay and

Table 1. Demographic characteristics of the studied population.

Characteristic	No. of samples		Positives		P value
	%	No.	%	No.	
Age(years)					
20-24	12.6	65	53.8	35	<0.05
25-29	12.6	65	66.2	43	
30-34	12.8	66	69.7	46	
35-39	12.8	66	87.9	58	
40-44	12.4	64	90.6	58	
45-49	12.3	63	88.9	56	
50-54	12.3	63	95.2	60	
55-60	12.1	62	95.2	59	
Sex					
Males	51.4	264	75	198	<0.05
Females	48.6	250	86.6	217	
Nationality					
Egyptian	14.6	75	78.7	59	>0.05
Yemen	14.2	73	76.7	56	
Sudan	14.4	74	87.8	65	
Pakistan	14.6	75	82.7	62	
Indian	14	72	66.7	48	
Bangladesh	14.2	73	83.6	61	
Ethiopian	14	72	88.9	64	
Ethnicity					
African	43	221	85.1	188	<0.05
Asian	57	293	77.5	227	

Table 2. Prevalence of cytomegalovirus by sex (males and Females).

Sex	No. of sample	Positive	(95%CI)	χ^2 (p)	
		%	No.		
Male	264	75	198	69.2 - 92.8	11.497(<0.05)
Female	250	86.8	217		
Total	514	80.7	415		

calculated separately for each age group, for each nationality, for male and female separately, and for foreign manpower as a whole using chi square test. The demographic characteristic of tested population was ages, sex, race and nationality as shown in Table 1.

Prevalence of cytomegalovirus by sex (males and Females)

The sero-prevalence of CMV in the tested population (was 80.7% (95% CI, 69.2 to 92.8%). CMV IgG was detected in the 415 of 514 of tested population. In the entire population, females (86.8%) were more likely than males (75%) to be CMV seropositive. CMV IgG was detected in the 217 of 250 (86.8%) female subjects and in 198 of 264 (75%) male subjects. There is significant difference in the seropositivity rate between the males and females ($p<0.05$). These were shown at Table 2 and Figure 1.

Prevalence of cytomegalovirus by age groups from 20 to 60 years old

The prevalence of CMV IgG showed a gradual increase

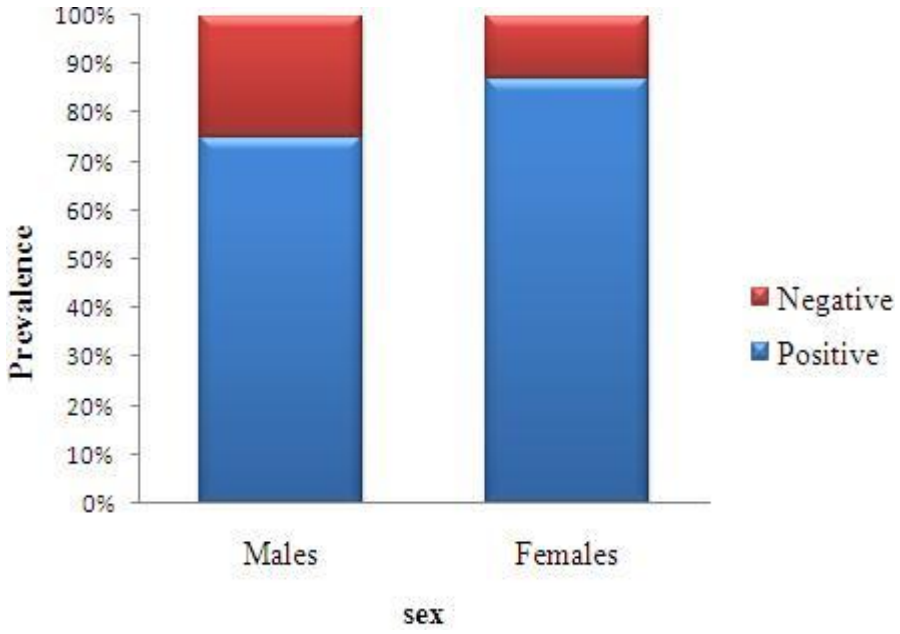

Figure 1. Prevalence of cytomegalovirus by sex (Males and females).

Table 3. Prevalence of cytomegalovirus by age groups from 20 to 60 years old.

Age group	No. of samples	Positive		Compared to age group 20 - 24	
		%	No.	(95%CI)	χ^2 (p)
20-24	65	50.8	35	41.0-61.8	Referent
25-29	65	66.2	43	61.5-72.1	2.051(>0.05)
30-34	66	69.7	46	62.2-77.8	3.486(>0.05)
35-39	66	87.9	58	83.5-91.3	18.418(<0.05)
40-44	64	90.6	58	85.1-96.9	21.682(<0.05)
45-49	63	88.9	56	81.7-97.5	19.117(<0.05)
50-54	63	95.2	60	92.0-99.2	28.646(<0.05)
55-60	62	95.2	59	88.1-98.9	28.163(<0.05)

with age. The chi-square test showed significant differences among the age groups using the first group (20 to 24 years old) as a reference. There were significant differences in prevalence between most tested groups ($P < 0.05$) except for groups aged 25-29 and 30-34 year. The highest prevalence was showed in the group aged 50 to 54 and 55 to 60 years, whereas the lowest prevalence was showed in the group aged 20 to 24 years the results were shown in Table 3 and Figure 2.

Prevalence of cytomegalovirus in females and males by age groups

Also gradual increase in the prevalence of cytomegalovirus was showed in females and males when divided to age groups. Seroprevalence continued to rise with age from 65.6% (95% CI, 60.1 to 69.9%) in 20 to 24-year-olds to 93.8% (95% CI, 87.1 to 99.1%) in 50 to 59-year-olds in female population as shown in Table 4 and Figure 3. Also seroprevalence continued to rise with age from 42.4% (95% CI, 34.3 to 50.1%) in 20 to 24-year-olds to 96.7% (95% CI, 88.2 to 99.8%) in 50 to 59-year-olds in male population. The prevalence of cytomegalovirus in males by age groups was shown in Table 5 and Figure 4.

Prevalence of cytomegalovirus by nationality

CMV IgG was detected in 59 (78.7%) of 75 Egyptian subjects, 56 (76.7%) of 73 Yemeni subjects, 65 (87.8%) of 74 Sudan subjects, 62 (82.7%) of 75 Pakistan subjects, 48 (66.7) of 72 Indian subjects, 61(83.6%) of 73 Bangladeshi subjects and in 64 (88.9%) of 72 Ethiopian subjects. The chi-square test showed significant differences among tested nationalities using the Indian

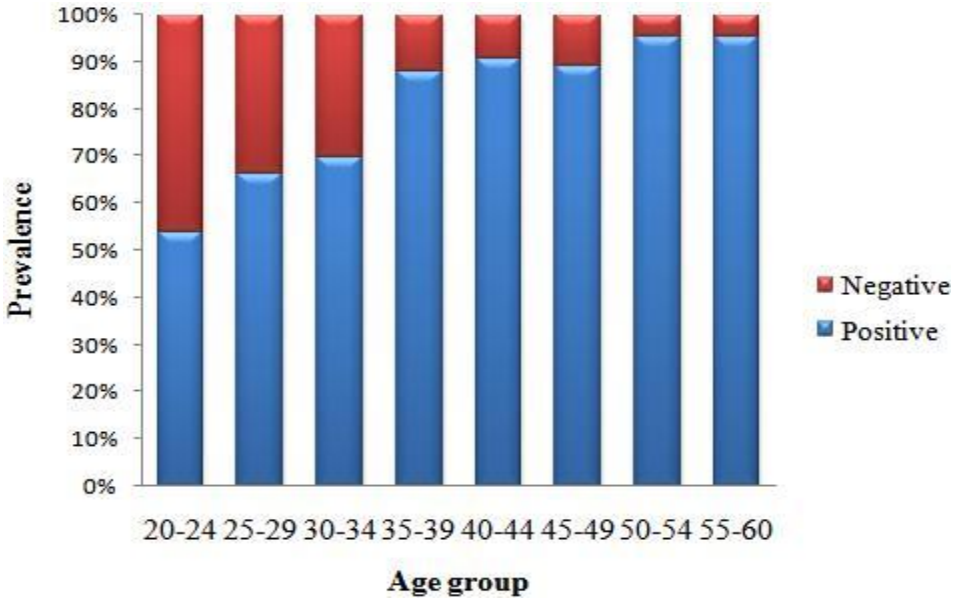

Figure 2. Prevalence of cytomegalovirus by age groups from 20-60 years old.

Table 4. Prevalence of cytomegalovirus in females by age groups from 20 to 60 years old.

Age group	No. of samples	Positive		Compared to age group 20 - 24	
		%	No.	(95%CI)	χ^2 (p)
20-24	32	65.6	21	60.1-69.9	Referent
25-29	33	78.8	26	74.8-83.6	1.406(>0.05)
30-34	32	90.6	29	84.7-98.5	5.851(<0.05)
35-39	32	90.6	29	84.8-96.8	5.851(<0.05)
40-44	30	93.3	28	84.9-99.5	7.174(<0.05)
45-49	29	89.7	26	81.5-98.1	4.968(<0.05)
50-54	30	93.3	28	84.9-98.5	7.174(<0.05)
55-60	32	93.8	30	87.1-99.1	7.819(<0.05)

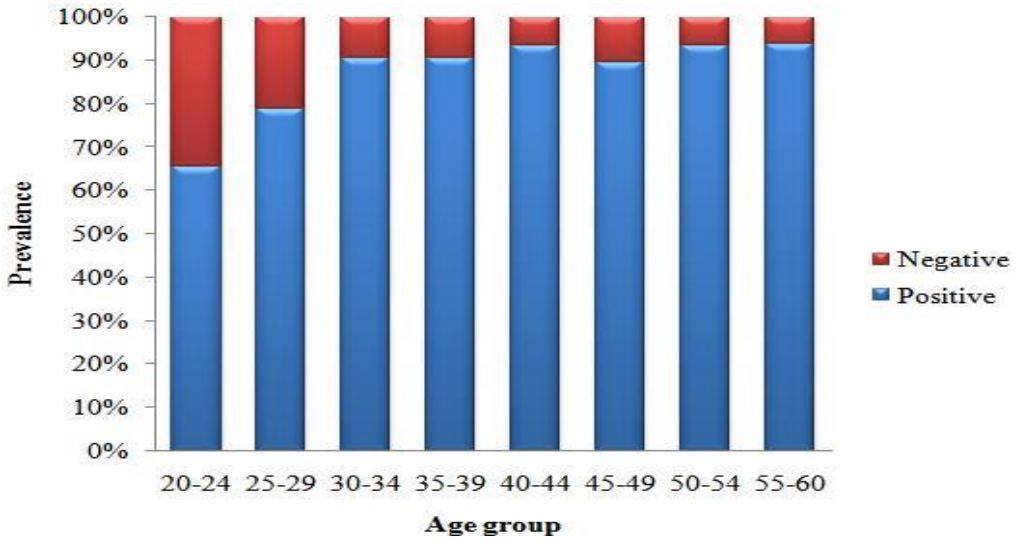

Figure 3. Prevalence of cytomegalovirus in females by age groups from 20-60 years old.

Table 5. Prevalence of cytomegalovirus in males by age groups from 20 to 60 years old.

Age group	No. of samples	Positive		Compared to age group 20 - 24	
		%	No.	(95%CI)	χ^2 (p)
20-24	33	42.4	14	34.3-50.1	Referent
25-29	32	53.1	17	47.5-60.5	0.746(>0.05)
30-34	34	50	17	41.9-56.1	0.387(<0.05)
35-39	34	85.3	29	81.9-87.9	13.387(<0.05)
40-44	34	88.3	30	81.9-94.1	15.589(<0.05)
45-49	34	88.3	30	81.9-94.1	15.589(<0.05)
50-54	33	96.9	32	91.5-98.5	23.243(<0.05)
55-60	30	96.7	29	88.2-99.8	21.338(<0.05)

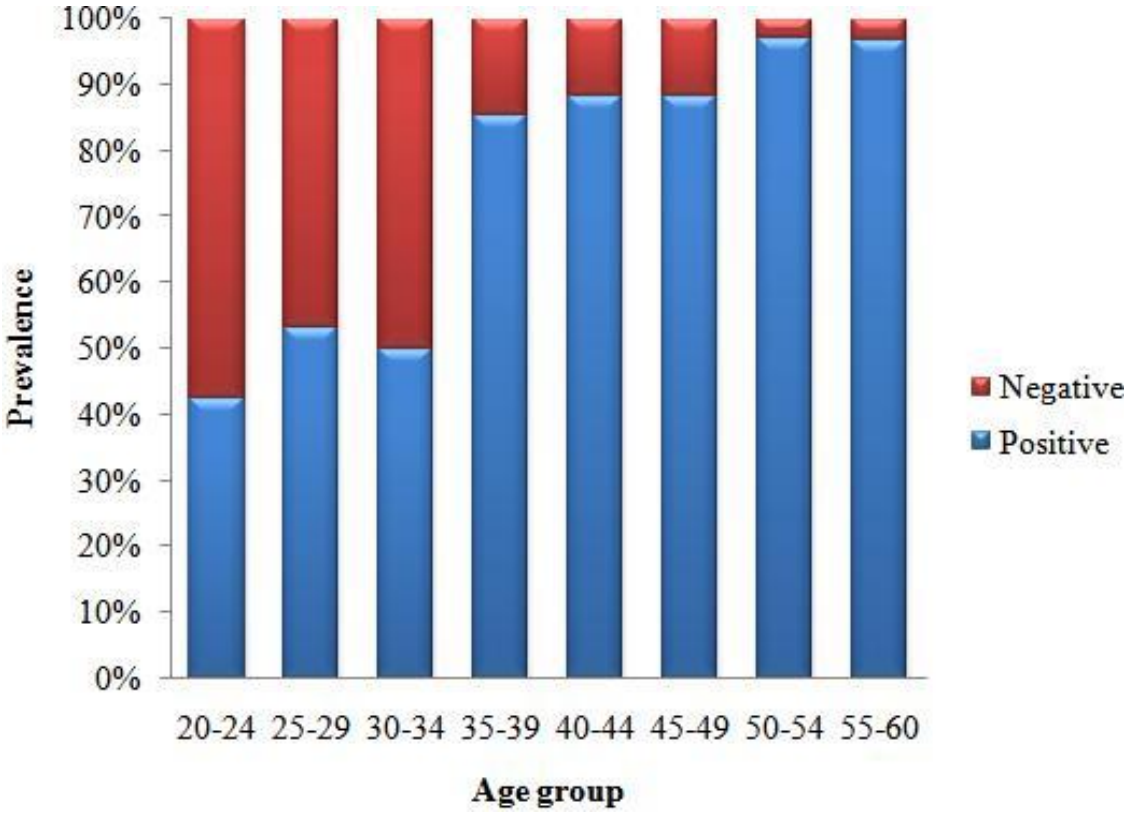

Figure 4. Prevalence of cytomegalovirus in males by age groups from 20-60 years old.

nationality as a reference. Prevalence was significantly higher among Sudani than among Indian ($P < 0.05$). The prevalence among Pakistani was significantly higher than among Indian ($P < 0.05$). The prevalence among Bangladeshi was significantly higher than among Indian ($P < 0.05$). The prevalence among Ethiopian was significantly higher than among Indian ($P < 0.05$), while the prevalence of Yemeni and Egyptian were not significantly different from that of Indian ($P > 0.05$) as shown in Table 6 and Figure 5. There were no significant differences in prevalence between all nationalities tested ($P < 0.05$).

Prevalence of cytomegalovirus by ethnicity

The prevalence of cytomegalovirus among African and Asian population showed that the prevalence of cytomegalovirus among African population (85.1%) was higher than among Asian population. The chi-square test showed significant differences in the prevalence of cytomegalovirus between African and Asian population

Table 6. Prevalence of cytomegalovirus by Nationality: (Egyptian; Yemeni; Sudan; Pakistan; Indian Bangladesh and Ethiopian).

Nationality	No. of samples	Positive		Compared to age group 20 - 24	
		%	No.	(95%CI)	χ^2 (p)
Indian	72	66.7	48	Referent	Referent
Egyptian	75	78.7	59	72.9-85.1	2.671(>0.05)
Yemen	73	76.7	56	73.5-79.5	1.804(>0.05)
Sudan	74	87.8	65	83.1-92.9	9.350(<0.05)
Pakistan	75	82.7	62	81.6-84.2	4.993(<0.05)
Bangladesh	73	83.6	61	70.6-96.4	5.544(<0.05)
Ethiopian	72	88.9	64	82.9-95.1	10.286(<0.05)

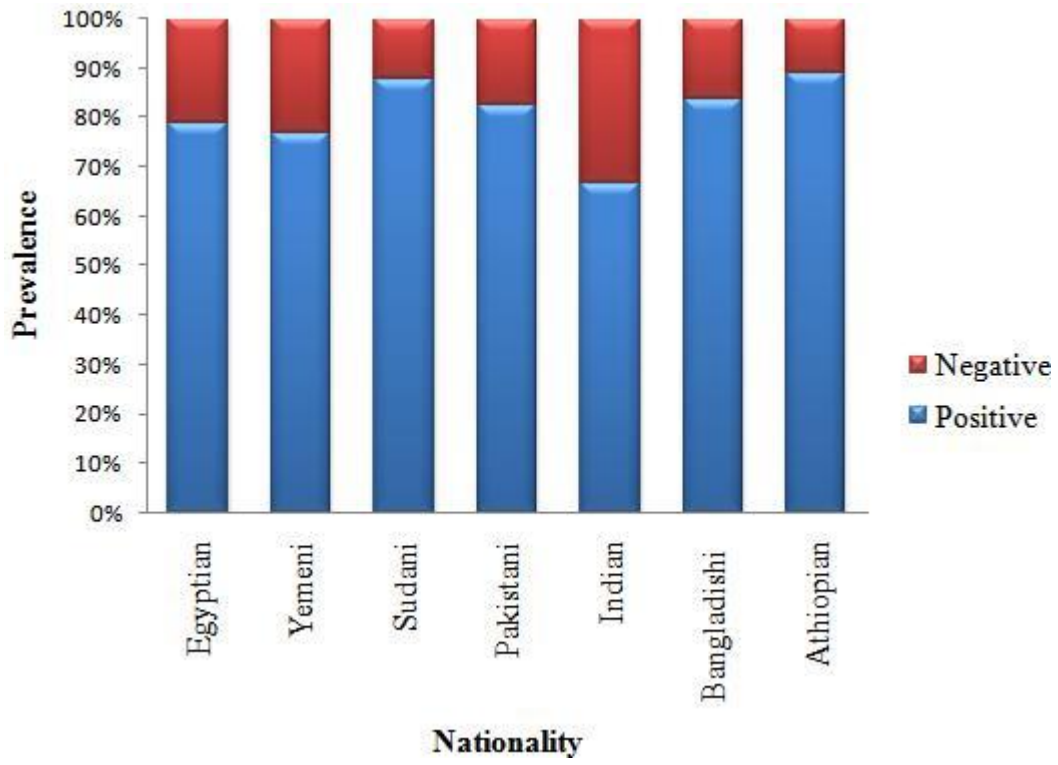

Figure 5. Prevalence of cytomegalovirus by nationality (Egyptian; Yemen; Sudan; Pakistan; Indian Bangladesh and Ethiopian).

(p<0.05). The results were shown in Table 7 and Figure 6.

DISCUSSION

CMV is a serious pathogen especially for immuno-compromised individuals and can be found all over the world. After primary infection, CMV establishes a lifelong latency, called a non-productive infectious state,in its host. Reactivation from latency occurs periodically throughout life in seropositive individuals which provides the stimulus for lifelong antibody positivity. CMV reactivation occurs mostly in immunosuppressed persons as well as in elderly because the immune system gets weaker with age (Kanapeckien÷ et al., 2007).

In our study, the enzyme linked immunosorbent assay was used for the detection of CMV IgG in foreign man-power from different nationalities in Jeddah region. The seroprevalence of CMV Ig G was 80.7% in studied popu-lation. The high prevalence rate indicates the endemicity of infection and suggestive of ubiquitous past exposure to infection, this perhaps could be related to socio-economic, environmental, and climatic factors. The seroprevalence of antibodies to CMV varies in different population and in different places. The results of our

Table 7. Prevalence of cytomegalovirus by Ethnicity **(**African and Asian).

Ethnicity	No. of sample	Positive		(95%CI)	χ^2 (p)
		%	No.		
African	221	85.1	188	75.0-89.0	4.671(<0.05)
Asian	293	77.5	227		
Total	514	80.7	415		

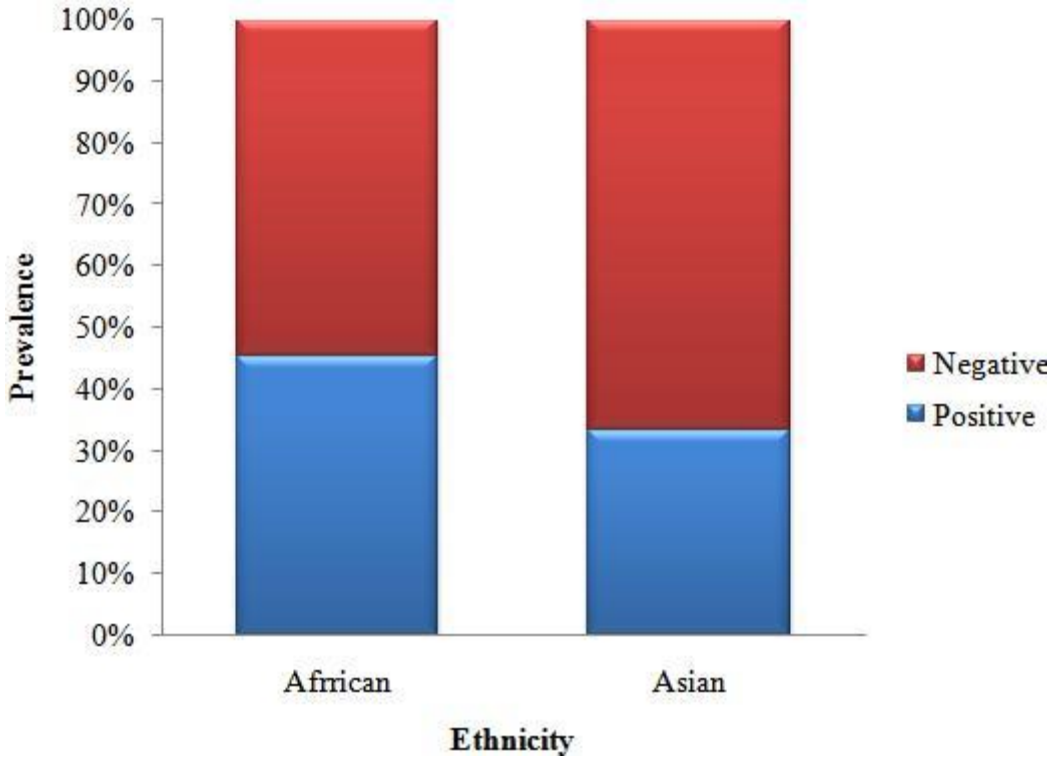

Figure 6. Prevalence of cytomegalovirus by Ethnicity (African and Asian).

study are generally consistent with those of other reports from developing countries where CMV infection occurs early in life both among normal and immunocompromised individuals. Likitnukul et al. (2003) found that the seroprevalence for anti-CMV IgG in children born to HIV 1 infected women in Thailand was 84.4% (Likitnukul et al., 2003), Adjei et al. (2008) reported that the seroprevalence of cytomegalovirus among some voluntary blood donors at the 37 military Hospital in Ghana was 93.2%. Adjei et al. (2008) and Ahmed et al. (2006) recorded that the prevalence of human cytomegalovirus seroposoitivity among blood donors at the unit of blood transfusion medicine in Malaysia was 97.6% (Ahmed et al., 2006), Ocak et al. (2006) found that seroprevalence of cytomegalovirus antibodies in haemodialysis Patients in Turkey was 99.6% (Ocak et al., 2006) and Kafi et al. (2009) reported that seroprevalence of Cytomegalovirus among blood donors and antenatal women in Sudan was 84% (Kafi et al., 2009).

The results of our study are different with those of other reports from developed countries and this perhaps due to the influence of many factors, such as hygienic circumstances, ethnic and socioeconomic factors, breastfeeding and sexual contacts. Seale et al. (2006) found that the prevalence of cytomegalovirus in Australia was 57% (Seale et al., 2006), Joseph et al. reported that cytomegalovirus seropositivity in a population of day care educators in Canada was 57% (Joseph et al., 2005), Gaytant et al. (2005) recorded that the Incidence of Congenital Cytomegalovirus Infections in Netherlands was 41% (Gaytant et al., 2005). In another study, carried out in an urban region of Germany, anti-CMV IgG antibodies were detected in 63.7% (Lübeck et al., 2009). In a study of pre-school children in New Zealand, a 32.8% seropositivity rate for anti-CMV IgG was found (O'Brien et al., 2009). Study of pregnant women in an Urban Area of Northern Italy reported CMV seroprevalence of 68.3% (Paschale et al., 2009).

Present study found an association between prevalence of cytomegalovirus and sex. We found significance differences in the prevalence of cytomegalovirus between males and females. This study found that the prevalence of cytomegalovirus was higher significantly in females (86.8%) than in males (75.0%). The most common mode of CMV transmission for adults is via exposure to toddlers. Infected infants and children, in particular those under 30 months old, actively excrete the virus in their saliva and urine. Thus, one hypothesis to explain the higher females CMV seroprevalence would be that women have more contact with children and have more opportunities for HCMV infection during pregnancy, delivery, and menstruation.

In the study reported herein, the seroprevalence of CMV IgG among the studied population varied with nationality and/or ethnicity ranging from 66.7% in Indian, 78.7% in Egyptian, 76.7% in Yemeni, 87.8% in Sudan, 82.7% in Pakistan, 83.6% in Bangladesh, to 88.9% in Ethiopian. The prevalence varied significantly with nationality when all nationalities compared with Indian nationality as reference ($p< 0.05$) except for the Egyptian and Yemeni nationality ($p>0.05$). In general the seroprevalence of cytomegalovirus among the African population (85.1%) varied significantly from Asian population (77.5%). The differences in the prevalence rate in different nationalities perhaps could be related to socio-economic factors, environmental, and climatic factors.

The result of the present study is consistent to the results of other researches carried out in different parts of world. Badami et al. (2009) reported that the ethnicity appeared to be related to seroprevalence of cytomegalovirus (CMV) in New Zealand between 2003 and 2006 and it ranging from 93.2% in Pacific Islanders, 54.8% in Caucasians, 80.4% in Maori, 77.6% in Asian, to 71.4% in Maori/Caucasian (Badami et al., 2009). The result of present study is also consistent to the result of another study carried out by Staras et al. (2006) between the year 1988 and 1994 to determine CMV prevalence in the US population. CMV seroprevalence differed by race and/or ethnicity as follows: 51.2% in non-Hispanic white persons, 75.8% in non-Hispanic black persons, and 81.7% in Mexican Americans. Racial and/or ethnic differences in CMV seroprevalence persisted when controlling for household income level, education, marital status, area of residence, census region, family size, country of birth, and type of medical insurance (Staras et al., 2006). Also similar results to our results shown in a study carried out by Gaytant et al. (2005) to investigate the incidence of congenital cytomegalovirus infections in the Netherlands. A significant difference ($P<0.0001$) in prevalence was observed between women of Dutch origin, of whom 35% were seropositive, compared to non-native women of whom 72 to 100% were positive. The seroprevalence among the most prevalent non-native groups in The Netherlands are 96% for women from Mediterranean countries (Morocco and Turkey) and 85% for women from Suriname and the Dutch Antilles, this differences may due to SES and in the category with a low SES in this study, more women were of non-native origin (Gaytant et al., 2005). The results of Colugnati et al. (2007) carried out to investigate the Incidence of cytomegalovirus infection among the general population and pregnant women in the United States also found that the force of infection was significantly higher among non-Hispanic Blacks (5.7) and Mexican Americans (5.1) than among non-Hispanic Whites. In this study, risk of primary CMV infection among seronegative women could be responsible for much of the racial/ethnic disparities (Colugnati et al., 2007). Knowles et al. study in the year 2006 that studied the seroprevalence of cytomegalovirus (CMV) in pregnant women in Ireland using ELISA test also reported that only 30.4% of Irish women were CMV antibody positive compared to 89.7% of non-Irish women. Non-Irish women were mostly from Sub-Saharan Africa, Eastern Europe and Asia. Lower socio-economic group and increasing number of children were significant independent predictors of CMV sero-positivity (Knowles et al., 2005).

The finding that the highest levels of CMV exposure occur in the first years of life suggests that, for a universal vaccination program to have maximal impact, the vaccine would need to be delivered to infants and have a long duration of protective efficacy. If the duration was only brief, a vaccine given just before pregnancy would be advised, or, if the vaccine had a medium duration of efficacy (5 years), regular boosters could be given throughout childbearing years. Concerns are raised with strategies based on targeting women prior to or during pregnancy. These include the cost and time related to the establishment of screening programs to identify CMV specific antibody in pregnant women.

In conclusion, 80.7% prevalence of CMV infection was identified in this foreign manpower and it confirm a high sero-prevalence of CMV infection studied population in the Jeddah region. Foreign manpower can be exposed to CMV infection. For this reason, we recommend that foreign manpower that is susceptible to CMV infection be identified by anti-CMV IgG- and IgM-specific serological tests. The seroprevalence of CMV IgG among the studied population varied with nationality and/or ethnicity, the highest rates of prevalence was found in Indian (66.7%) and the lowest rates of prevalence was found in Ethiopian (88.9%). The high prevalence rate indicates the endemic of infection and suggestive of ubiquitous past exposure to infection and this perhaps could be related to socio-economic, environmental, and climatic factors. This study found that prevalence of cytomegalovirus was higher significantly in females (86.8%) than in males (75.00%). One hypothesis to explain the higher females CMV seroprevalence would be that women have more contact with children. The seroprevalence of CMV IgG among the studied population increased gradually with age from 50.8% in 20 to 24 year age group to 95.2% in

the 50 to 54 and 55 to 60 year age groups. One hypothesis to explain the high prevalence in elderly would be that the immune system of elderly gets weaker with age. Moreover, aging is associated with a marked accumulation of dysfunctional CMV-specific CD8 + T cells together with a decrease in immediate effectors function.

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