Hepatitis B infection in Yemenis in Sana'a: pattern and risk factors

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عدوى التهاب الكبد البائي بين اليمنيين في صنعاء: نمط العدوى وعوامل الاختطار

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خلاصـة: أُجريـت دراسـة وبائيـة مصـلية مقطعية على 2652 شخصاً (تراوحـت أعمارهـم بين شهر واحد و95 سنة، وكان العمـر الوسـيط 23 سنة) مـن مراجعي المختبر الصحي المركزي بصنعاء، في إطار حملة لمكافحة فيروس التهاب الكبد البائي. وتـمت فحوص التحرّي بطريقة التراص الدموي المنفعل العكسي، وتم تعيـين نوعية العينات الإيجابية بالمقايسة المناعية الإنزيمية. ومن بين 2321 مشاركاً وُجد أن 7.4% كانوا يحملون المستضدّ السطحي لالتهاب الكبد البائي. أما عوامل الاختطار التي تم تعيينها بالتحليل ذي المتغيرين فكانت العمر والجنس ومكان الإقامة، والتعرُّض للأدوات القاطعة والواخزة ونقل الدم. وأظهر التحليل العدد المتغيِّرات أن العمر هو أفضل عوامل التكهُّن بمعدل حَمَلة فيروس التهاب الكبد البائي.

ABSTRACT A cross-sectional seroepidemiological study was conducted among 2652 individuals (age range: 1 month–95 years; median 23 years) who presented at Sana'a Central Health Laboratory in response to a campaign to control hepatitis B virus. Screening was carried out by reverse passive haemagglutination. Specificity of positive samples was determined by enzyme immunoassay. Of 2321 participants, 7.4% were carriers of hepatitis B surface antigen. Risk factors determined by bivariate analysis were age, sex, residence, exposure to cutting and puncturing tools and blood transfusion. Multivariate analysis revealed age to be the best predictor of the carrier rate of hepatitis B virus.

L'infection par le virus de l'hépatite B chez les Yéménites à Sanaa : tableau et facteurs de risque
RESUME Une étude séro-épidémiologique transversale a été réalisée sur 2652 personnes (âge compris entre 1 mois et 95 ans ; médiane 23 ans) qui se sont présentées au laboratoire de santé central de Sanaa suite à une campagne de lutte contre le virus de l'hépatite B. Le dépistage a été réalisé par hémagglutination passive inversée. La spécificité des échantillons positifs a été déterminée par dosage immuno-enzymologique. Sur 2321 participants, 7,4 % étaient porteurs de l'antigène de surface de l'hépatite B. Les facteurs de risque déterminés par l'analyse bivariée était l'âge, le sexe, la résidence, l'exposition à des instruments coupants ou perforants et la transfusion sanguine. L'analyse multivariée a révélé que l'âge était le meilleur élément prédictif du taux de portage du virus de l'hépatite B.

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Introduction

Worldwide, an estimated 350 million chronic carriers of hepatitis B virus (HBV) are at high risk of liver cirrhosis and cancer [1]. Chronic carriers of HBV constitute more than 10% of the populations of tropical Africa and East Asia [2].

The Ministry of Public Health in the Republic of Yemen ranks HBV infection 12th on its list of major public health problems [3]. In two separate studies on non-probability samples of pregnant women in Sana'a, carrier rates of hepatitis B surface antigen (HBsAg) of 11.5% and 15.4% were reported [4,5]. Other studies, in 1990 [6] and in 1993 [7], revealed carrier rates of 12.7% and 18.5% respectively.

While the mode of transmission is well known, patterns of HBV infection and associated risk factors in the Yemeni population have not been adequately investigated. Previous studies in the Republic of Yemen indicate age to be positively correlated with acquiring the infection [4–6]. A previous history of blood transfusion and hospitalization [4], or blood transfusion and abortion [5] are also considered risk factors.

We aimed to describe the pattern of HBV infection, estimate prevalence, investigate possible risk factors and provide a detailed description of carrier characteristics in an adequate sample size, with relatively low bias. The study also investigated environmental, occupational, social and behavioural factors in relation to infection rates, in order to provide baseline information for setting priorities on immunization and for future studies.

Methods

A total of 2652 individuals (age range: 1 month–95 years; median 23 years) who presented at Sana'a Central Health Laboratory in response to a campaign to control HBV infection were recruited into the study. They were divided into two groups. Group 1 (n = 2321) was used to look at HBV prevalence and patterns of infection. This group included 1600 people (800 who presented individually and 800 who were members of 165 families) and 721 blood donors. Excluded from Group 1 were those who had been previously screened for HBsAg. Group 2, made up of 331 individuals who had been tested previously, was used to study risk factors.

The screening was carried out by reverse passive haemagglutination testing (SERODIA-HBs). The specificity of this method in positive samples was re-examined using an enzyme immunoassay (PATHOZYME-HBsAg, Abbott Laboratories). All the participants were investigated for social (marital status), behavioural (sharing sharp instruments), cultural (educational status) and occupational associations, using questionnaires completed by the investigators. Data were collected over a 4-month period (June–September, 1999). Data were analysed using SPSS, version 9.1.

Results

Of the total number of participants tested, 221 were HBsAg-positive. Tests performed on the 2321 sera samples revealed an HBsAg prevalence of 7.4%. Among the individuals who presented with their families, the prevalence was 3.4% (average family size 4.86 persons). A prevalence rate of 7.1% was found among the 721 blood donors. Of those presenting individually (n = 800), the prevalence rate was 7.6%.

HBsAg carrier rates among different age groups are shown in Figure 1. Only in
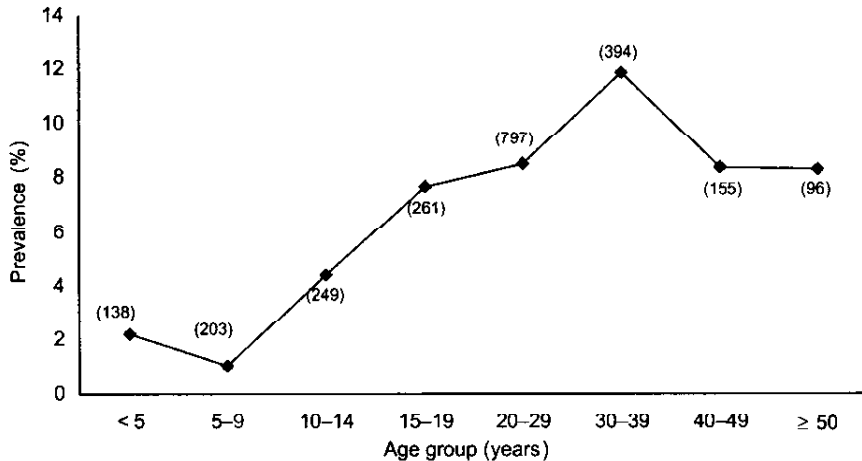
Figure 1 Hepatitis B surface antigen carrier rate among different age groups of the 2321 participants in Group 1, Sana'a, 1999. Figures in brackets are the number of participants in each age group. The total number examined was 2293 as 28 participants did not disclose their ages.

16 out of the 165 families tested did at least one family member test positive. Among the families with positive cases: in 4 families the mother plus one or more other family member tested positive; in 4 families, only the father was positive; in 3 families, the father plus at least one other family member were positive; and in 6 families, neither parent was positive, only one or more sibling. Among those with a previous history of jaundice (n = 149), the HBsAg carrier rate was 5.4%, compared to 7.5% among those without any previous history (n = 2126). This may indicate a high frequency of other types of hepatitis infection. Other factors studied in relation to HBsAg carrier rate among the 2321 individuals in Group 1 are shown in Table 1.

Bivariate analysis for the 2652 total sample showed a positive association between carrier rate and male sex, older age,

rural residence, past history of shared use of sharp instruments and blood transfusion. Marital status and direct contact with a jaundiced individual were not related (Table 2).

Multiple regression was used to determine the extent to which age was a predictor of carrier rate, adjusting for those factors found positive under bivariate analysis. Using a gold standard and backward elimination, residence, blood transfusion and shared use of sharp devices were excluded. Only age and sex continued to be significant. Further, the odds ratio for age was comparable in the crude model and gold standard (1.0221 and 1.0177 respectively). Age alone was, therefore, considered the best predictor of infection, according to the following equation:

Logit (rate of infection) = –2.932 + 0.0218 × age (continuous)

Table 1 **Hepatitis B surface antigen (HBsAg) carrier rate according to the characteristics of the 2321 participants in Group 1, Sana'a city, 1999**

Characteristic	Positive		Negative		Total no.	χ^2	P-value
	No.	%	No.	%			
Sex						11.92	0.000
Male	139	8.7	1465	91.3	1604		
Female	33	4.6	684	95.4	717		
Residence[a]						8.83	0.005
Urban	115	6.8	1582	93.2	1697		
Rural	19	13.6	121	86.4	140		
Occupation[b]						12.64	0.081
Student	24	7.9	281	92.1	305		
Housewife	18	6.5	257	93.5	275		
Manual worker	50	13.2	328	86.8	378		
Office employee	22	8.2	247	91.8	269		
Teacher	9	11.4	70	88.6	79		
Soldier	13	8.4	141	91.6	154		
Self-employed business man	2	7.1	26	92.9	28		
Medical staff	3	21.4	11	78.6	14		
Marital status[c]						0.09	0.788
Ever married	102	9.4	984	90.6	1086		
Never married	39	8.8	404	91.2	443		
Literacy[d]						5.13	0.163
Illiterate	21	8.9	216	91.1	237		
Read and write	25	11.5	192	88.5	217		
School level	86	7.1	1119	92.9	1205		
Higher studies	37	8.1	421	91.9	458		
Family status						28.98	0.000
Family member	27	3.4	773	96.6	800		
Single	145	9.5	1376	90.5	1521		

[a]*Residence: 484 subjects were excluded; 253 from other governorates and 230 did not answer.*
[b]*Occupation: 819 subjects were excluded; 794 < 19 years and 25 did not answer.*
[c]*Marital status: 792 were excluded; 777 < 19 years and 15 did not answer.*
[d]*Literacy: 204 were excluded; 178 < age of marriage and 26 did not answer.*

Discussion

Our study revealed a lower carrier rate in families (3.4%) than reported from Sana'a (11.5% to 18.5%) [4–6], Taiz [7] and other areas [6]. Also, unlike the earlier findings, our result is lower than that reported from Saudi Arabia (6.7%), the Republic of Yemen's northern neighbour.

The HBsAg carrier rate found in our study suggests that Sana'a city can be classified as an intermediate, rather than high, infection area. The relatively low rate of infection (3.5%) in the < 15 years age group,

Table 2 Risk factors associated with hepatitis B surface antigen (HBsAg) carrier status in the 2652 participants (Groups 1 and 2), Sana'a city, 1999

Risk factor	Positive		Negative		Total no.	χ^2	P-value
	No.	%	No.	%			
Sex						13.66	0.000
Male	179	9.6	1680	90.4	1859		
Female	42	5.3	751	94.7	793		
Residence[a]						11.12	0.002
Rural	24	15.1	135	84.9	159		
Urban	145	7.6	1771	92.4	1916		
Age (years)[b]						28.43	0.000
< 15	23	3.5	641	96.5	664		
≥ 15	198	10.1	1759	89.9	1957		
Past history[c]						6.18	0.010
Exposed	49	11.4	382	88.6	431		
Not exposed	166	7.7	1979	92.3	2145		
Blood transfusion[d]						6.99	0.010
Yes	18	15.0	102	85.0	120		
No	199	8.1	2250	91.9	2449		
Direct contact[e]						5.26	0.070
Yes	27	12.6	187	87.4	214		
No	188	8.1	2133	91.9	2321		
Marital status[f]						1.79	0.104
Ever married	135	10.8	1115	89.2	1250		
Never married	45	8.7	473	91.3	518		

[a]*Residence: 577 were excluded; 306 from other governorates and 271 did not answer.*
[b]*Age: 31 did not answer.*
[c]*Past history: 76 did not answer.*
[d]*Blood transfusion: 83 did not answer.*
[e]*Direct contact: 117 were excluded; 16 did not know and 101 did not answer.*
[f]*Marital status: 884 were excluded; 862 < 19 years and 22 did not answer.*

compared to 10.1% in the ≥ 15 years age group, indicates that most infection occurred as a result of lifestyle and behavioural factors rather than environmental or host factors. The rate of 2.2% in early age (< 5 years) points to probable vertical transmission and/or early parenteral exposure (circumcision or ear puncture). The lowest prevalence rate (1.0% at age 5 years) suggests the elimination of antigens from the system. The rate increased steadily with increased age, until it peaked at 11.9 % (in the age group 30–39 years) and

then reverted to rates comparable with those in the 20-year-old age group.

Our study also revealed the years of greatest incidence to be 10–19 years and 30–39 years. From this, we can infer that immunization at ages 9, 14 and 29 years could substantially reduce the carrier rate.

The high rate found among teachers (11.4%, $n = 79$) and also among family members whose mothers were infected supports the view that being in close contact with carriers increases the risk of infection. Our finding that rural residents had

a higher carrier rate (15.1%) than urban residents (7.6%) is contrary to Al-Faleh's findings [8]. The rural–urban difference in the present study was eliminated when backward multiple regression was applied, suggesting that only older, male villagers tend to visit the cities.

When we looked at the best predictors for occurrence of infection, age and sex continued to be significant, while residence, sharing of sharp instruments and blood transfusion were eliminated. This would seem logical, as with ageing, bleeding experiences increase. Thus, age can substitute for other predictors, a finding compatible with those of Al-Shamahy, Abdel Raheem and Scott [4–6].

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