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Factors Associated with Intrafamilial Transmission of Hepatitis B Virus Infection in Korea

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Epidemiologic and serologic data on 137 household contacts of 51 chronic carriers of HBsAg and 111 household contacts of 38 controls who were negative for serologic markers of hepatitis B virus(HBV) were obtained from March 1990 to August 1991. Using this data, possible routes of intrafamilial transmission of hepatitis B virus among household contacts of chronic carriers of hepatitis B surface antigen (HBsAg) were evaluated and analyzed. The HBsAg prevalence among the household contacts of carriers was 14.1%(95% CI 7.8-24.0) compared to 0.0 % (95% CI 0.0-7.0) among those of controls($P<0.01$). The offspring of carriers showed significantly higher risk of HBV infection(relative risk; 6.6). Sharing of towels and handkerchieves, and drinking vessels was associated with an increased risk of HBV infection via intrafamilial transmission in Korea (relative risk 11.5 for towel and handkerchief, 12.1 for drinking vessels).

Key Words: *Hepatitis B virus, Intrafamilial transmission.*

INTRODUCTION

Hepatitis B virus(HBV) infection is highly prevalent in Korea(Ahn et al., 1992; Yoo et al., 1990) and is known as the major etiologic factor of chronic and acute liver diseases as well as hepatocellular carcinoma(Lee et al., 1990; Ahn et al., 1990; Yoo et al., 1991). High prevalence of HBV infection has caused chronic liver diseases to be the 4th most common diagnosis of inpatients in Korea(KMIC, 1991), and raised the age adjusted incidence rates of liver cancer among Koreans to 30.5 and 7.6/100,000 in males and females, respectively(Ahn et al., 1989).

Transmission of HBV ordinarily requires close contact with the patients or the equivalent of a parenteral inoculation of infective material. The former is called a non-parenteral route, the latter parenteral. Prevention and control of parenteral routes of HBV transmission have been undertaken by high standards of general and medical hygienic measures and through HBsAg screening of pregnant women, Hepatitis B immune globulin injections, and Hepatitis B vaccinations of neonates born to HBsAg positive mothers. As the parenteral transmission of HBV is currently controllable, the non-parenteral routes remain the major transmission mode to be controlled in the future. Many seroepidemiological and/or anecdoctal reports have identified familial aggregation of HBV infection(Szmuness et al., 1973; Kashiwag et al., 1988; Hann et al., 1982). The familial clustering suggests that HBV is transmitted by close contact between family members in the household, presumably through the inapparent peroral, permucosal, or percutaneous passage of HBV during direct or indirect personal contacts. However, studies on the factors associated with intrafamilial transmission of HBV infection are too few to be conclusive. To re-evaluate the familial clustering of HBV infection

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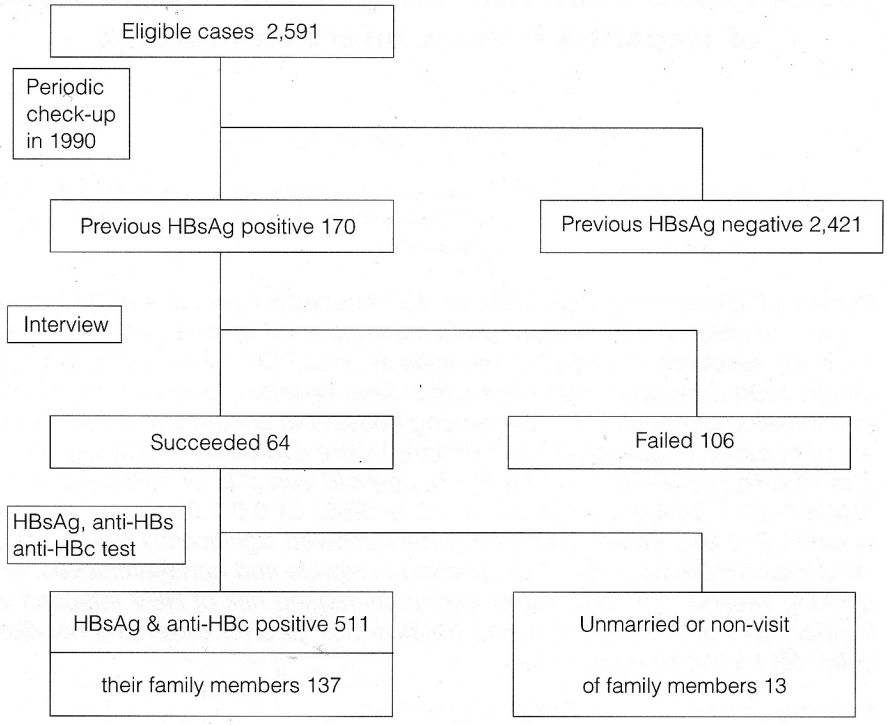

Fig. 1. Schematic presentation of cases and their family members selection

and to elucidate possible factors associated with the risk of intrafamilial transmission of HBV in Korea, a case-control study of household contacts of chronic carriers of HBsAg was carried out.

MATERIALS AND METHODS

Selection of chronic carriers of HBsAg and their household contacts(case group)

From a group of 2,591 government employees, school teachers and staff who were assigned to Asan Medical Center and HanYang University Hospital for their 1990 free biannual health screening, one hundred seventy HBsAg positive cases diagnosed at their initial screens(1986 or 1988) were enlisted as potential chronic carriers. We asked them and their family members to participate in this study. Sixty four (38%) responded to our request for the retest of HBV markers and interview. Of a total 13 cases were excluded for lack of HBsAg and anti-HBc positivity at retest, or because they were living alone, or because other family members did not come with the case. Finally, 51 chronic carriers confirmed by retest, and their 137 household contacts formed the case group in this study(Fig. 1).

Selection of susceptibles to HBV and their household contacts(control group)

A group of 1,293 subjects, who were negative for HBsAg in 1986 or 1988 and diagnosed as normal at the 1990 health screening, were screen-tested for HBsAg and anti-HBs in 1990. Out of which 311 cases remained negative both for HBsAg and anti-HBs in the screening test and 61 (25%) responded to our request for the retest of HBV markers and interview. A total 23 cases were excluded for anti-HBc positivity at retest, or because they were living alone, or because other family members did not come with the case. Finally, 38 who were negative for all three markers of HBV (HBsAg, anti-HBs, and anti-HBc), and their 111 household contacts participated in this study as the control group(Fig. 2).

Carriers and controls(susceptibles) did not differ with respect to sex, age, education level, and fam-

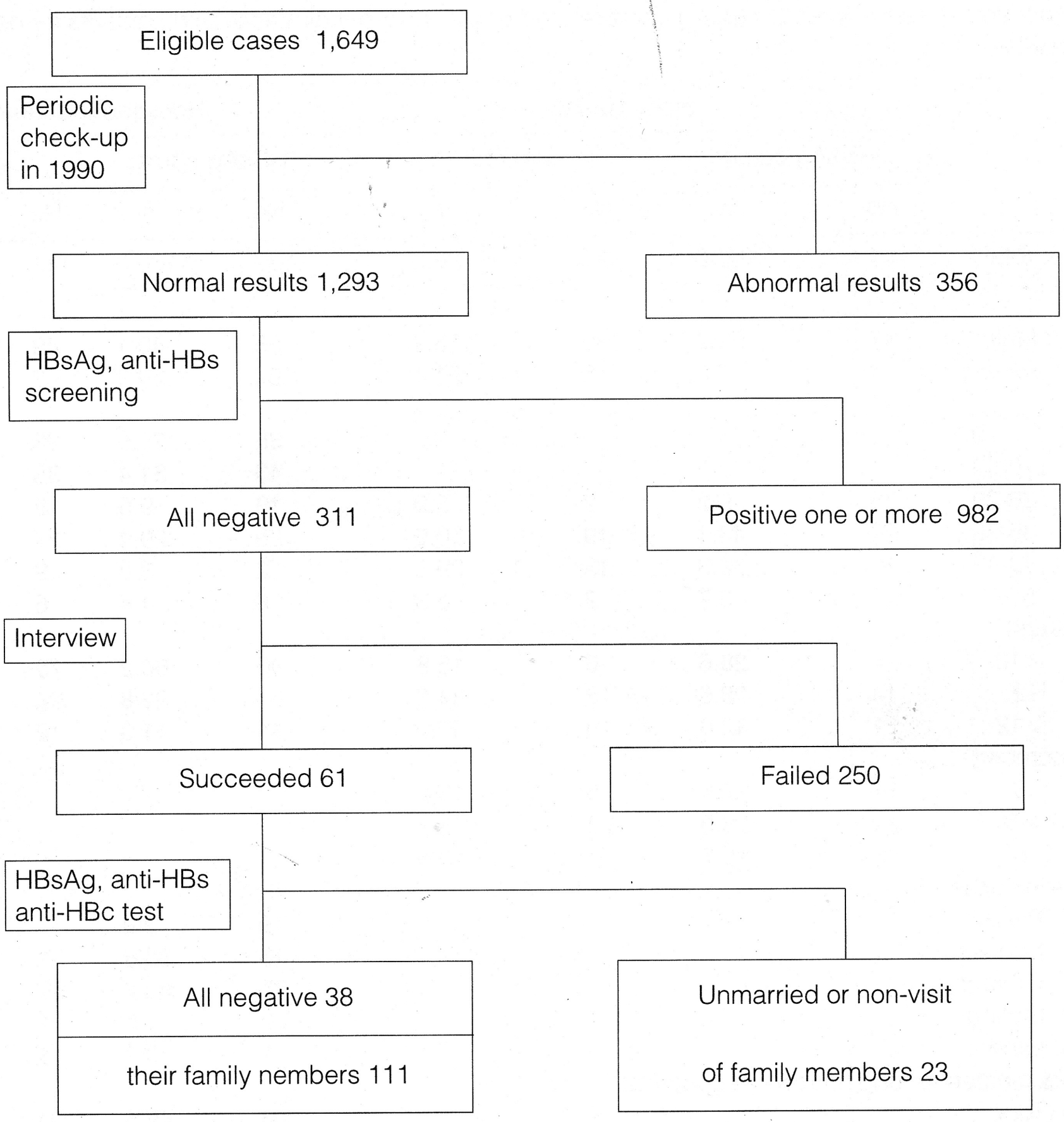

Fig. 2. Schematic presentation of controls and their family members selection

ily size. And the household contacts of carriers and controls also did not differ with respect to sex, age, education level, or distribution of relationship to the index case (Table 1).

Serological tests for HBV markers

Sera were stored at -60°C and subsequently tested for various HBV markers by Radioimmunoassay(RIA) at Asan Medical Center, Seoul. The assayed markers were HBsAg, anti-HBs and anti-HBc(AUSRIA, AUSAB, CORAB respectively by Abbott).

Data collected by interview

All participants were interviewed for past medical history, social history and family life behavior which might contribute to non-parenteral spread of HBV. Past medical histories included dental procedures, operations, blood transfusions, acute viral hepatitis, sexually transmitted diseases, acupuncture use, tatoos, pierced ears and HB vaccination. Social histories included education level, employment in the medical field, duration of marriage, smoking and alcohol consumption. Elicited family life behaviors included sharing of bedroom, bedding, towels and handkerchieves, washcloths, razors, combs, toothbrushes, eating utensils(spoons and chopsticks), and drinking vessels(cup and glass). Whether foods such as stew, kimchi, water kimchi and pickled fish were shared from one dish or served in individual dishes was also asked. Traditionally in the Korean home, all the household members usually eat together food served in one dish except rice.

Table 1. Distribution of index cases of HBsAg carriers[a] and controls[b] and their household contacts by demographic variables

Variables		Index Cases				Household Contacts of			
		HBsAg carrier		Control		HBsAg carrier		Control	
		No.	%	No.	%	No.	%	No.	%
	Total	51	100.0	38	100.0	137	100.0	111	100.0
Sex									
	Male	47	92.2	30	78.9	55	40.1	49	44.1
	Female	4	7.8	8	21.1	82	59.9	62	55.9
Age(year)									
	9	-	-	-	-	35	25.5	28	25.2
	10-19	-	-	-	-	43	31.4	38	34.2
	20-29	5	9.8	2	5.3	13	9.5	3	2.7
	30-39	22	43.1	19	50.0	28	20.4	27	24.3
	40-49	17	33.3	15	39.5	12	8.8	9	8.1
	50	7	13.7	2	5.3	6	4.4	6	5.4
Education(years)									
	<12	14	28.6	6	15.8	90	66.2	75	67.6
	12	14	28.6	13	34.2	31	22.8	24	21.6
	>12	21	42.8	19	50.0	15	11.0	12	10.8
Family size(number)									
	3	14	27.5	5	13.2				
	4-5	29	56.9	29	76.3				
	6	8	15.7	4	10.5				
Relation to index case									
	Parent	-	-	-	-	3	2.2	7	6.3
	Spouse	-	-	-	-	46	33.6	31	27.9
	Offspring	-	-	-	-	85	62.0	66	59.5
	Sibling	-	-	-	-	2	1.5	4	3.6
	Others	-	-	-	-	1	0.7	3	2.7
Hepatitis B vaccinated among household contacts[c]									
	Total					66	48.5	60	54.1
	Parent					1	33.3	0	0.0
	Spouse					13	28.3	5	16.1
	Offspring					52	61.2	53	80.3*
	Sibling					0	0.0	0	0.0
	Others					0-	0.0	2	66.7

a) HBsAg carrier : those who were HBsAg positive 2 or 4 years ago and are both HBsAg and anti-HBc positive 2 or 4 years later.
b) control : those who were both HBsAg and anti-HBs negative 2 or 4 years ago and are negative for all markers of HBV (HBsAg, anti-HBs and anti-HBc) 2 or 4 years later
c) the percentage refers to the proportion among those who have same relation to the index cases.
* $p<0.05$ (x^2 test)

Data analyses

Household contacts of both carriers and controls were considered to have HBV infection if anyone of the following was positive: HBsAg, anti-HBs and anti-HBc. Those who received HBV vaccination were excluded from analysis. Those who had HB vaccination were 66(48.5%) out of 137 household contacts of carriers, and 60(54.1%) out of 111 household contacts of controls. Two non-vaccinated offspring of female carriers(mother) were excluded from analysis because the possibility of perinatal infection could not be ruled out. Familial clustering was examined by the difference in the prevalence of HBV infection among household contacts of carriers and controls.

We first examined the crude odds ratios of past medical histories and factors other than family life

Table 2. Prevalence of HBsAg and hepatitis B virus infection[a] among non-vaccinated household contacts of carriers and controls by relationship to the index case

Relationship to the index case	Household contacts of carriers			Household contacts of controls		
	No.of non-vaccinated	Positive of HBsAg No.(%)	Positive of HBV infection No.(%)	No.of non-vaccinated	Positive of HBsAg No.(%)	Positive of HBV infection No.(%)
Parent	2	0(0.0)	2(100.0)	7	0(0.0)	6(85.7)
Spouse	33	1(3.0)	28(84.9)	26	0(0.0)	21(80.8)
Offspring	33	8(24.2)	18(54.6)*	13	0(0.0)	2(15.4)*
Sibling	2	1(50.0)	1(50.0)	4	0(0.0)	3(75.0)
Other relatives	1	0(0.0)	1(100.0)	1	0(0.0)	1(100.0)
Total	71	10(14.1)**	50(70.4)	51	0(0.0)**	33(64.7)

a) Positive for at least one hepatitis B marker (HBsAg, anti-HBs, or anti-HBc)
* $P < 0.05$ by Fisher's exact test, Mantel Haenszel estimates of odds ratio ; 6.6 with 95% CI of 1.3-34.5
** $P < 0.01$ by Fisher's exact test, 95% CI ; 7.8-24.0% for household contacts of carrier and 0.0-7.0% for those of control.

Table 3. Prevalence of hepatitis B infection[a] among non-vaccinated offspring of carriers and controls by sex

Sex	Offsprings of carriers		Offsprings of controls		P value	OR	(95%CI)[b]
	No.	Positive(%)	No.	Positive(%)			
Son	22	13 (59.1)	8	1 (12.5)	0.029	10.1	(1.1-97.0)
Daughter	11	5 (45.5)	5	1 (20.0)	0.346	3.3	(0.3-40.3)
Total	33	18 (54.6)	13	2 (15.4)	0.016	6.6	(1.3-34.5)

a) Positive for at least one hepatitis B marker (HBsAg, anti-HBs, or anti-HBc)
b) Mantel Haenszel estimates

behavior, in the household contacts with evidence of HBV infection versus those without evidence of HBV infection. Separate comparisons among household contacts of controls from carriers have been done in order to find the potential confounders in the data that might be related to both status of household group and HBV infection.

Household contacts of carriers with evidence of HBV infection were compared with those without evidence of HBV infection in respect to family life behavior, in terms of sharing of various home life items with the carrier. The odds ratio was used as an estimate of relative risk(RR). The Mantel-Haenszel method was used to obtain an adjusted RR and 95% confidence intervals(CI) controlling for the potential confounding effects of selected variables.

RESULTS

Familial clustering of HBV infection

Of 71 non-vaccinated household contacts of carriers, 10 tested positive for HBsAg(14.1%), but none of the household contacts of controls were positive for HBsAg ($P<0.01$). Of the 10 who tested positive for HBsAg 8 were the offspring of carriers (Table 2).

70.4% of non-vaccinated household contacts of carriers were positive for HBV infection. This was not significantly different from 64.7% HBV infection rate of household contacts of controls ($P>0.05$). However, when the offspring of carriers and controls were compared, a significantly higher percentage of the offspring of carriers were positive for HBV infection (54.6% vs 15.4%, $P<0.05$) with a RR of 6.6(95% CI; 1.3-34.5)(Table 2). When offspring were further divided by sex, 59.1% of sons of carriers and 12.5% of sons of controls were

Table 4. Distribution of the HBV infected and non-infected among non-vaccinated household contacts of HBsAg carrier and control by potential risk factors in terms of past medical history

Potential risk factor	Household contacts of carrier			Household contacts of control		
	HBV Infected[a] No.(%)	Non-infected No.(%)	P value	HBV Infected No.(%)	Non-infected No.(%)	P value
Total	50 (100.0)	21 (100.0)		34 (100.0)	17 (100.0)	
Prior operation	19 (38.0)	1 (4.8)	0.004[b]	16 (47.1)	3 (17.7)	0.038[c]
Prior blood transfusion	2 (4.0)	0 (0.0)	0.487	6 (18.2)	0 (0.0)	0.070
Prior endoscopy	7 (14.0)	1 (4.8)	0.248	5 (14.7)	2 (3.9)	0.571
Tooth extraction	25 (50.0)	5 (23.8)	0.041[d]	21 (61.8)	8 (47.1)	0.318
Acupuncture use	10 (20.0)	2 (9.5)	0.239	15 (44.1)	9 (52.9)	0.552
Tattooed	2 (4.0)	0 (0.0)	0.493	1 (2.9)	0 (0.0)	0.667
Pierced ear	10 (20.0)	4 (19.1)	0.603	7 (20.6)	4 (23.5)	0.731
Contact with non-household member with hepatitis	0 (0.0)	1 (5.0)	0.286	0 (0.0)	0 (0.0)	

a) Positive for at least one hepatitis B marker (HBsAg, anti-HBs, or anti-HBc)
b) The Mantel - Haenszel estimates of odds ratio and their 95% CI were 12.3 (1.5 - 98.9).
c) The Mantel - Haenszel estimates of odds ratio and their 95% CI were 4.1 (1.0 - 17.1).
d) The Mantel - Haenszel estimates of odds ratio and their 95% CI were 3.2 (1.0 - 10.1).

NOTE: the combined odds ratios(95% CI) for prior operation and tooth extraction were 6.5 (2.2-18.9) and 2.5 (1.1 - 5.5), respectively.

Table 5. Distribution of the HBV infected and non-infected among non-vaccinated household contacts of carrier by possible routes of household transmission in Korea

Variables	Infected[a] No.(%)	Non-infected No.(%)	x^2 [b]	OR	(95%CI)[c]
Total	44[d] (100.0)	21 (100.0)			
Bedroom sharing	34 (77.3)	10 (47.6)	0.89		
Bed/bedding sharing	30 (71.4)	7 (36.8)	0.99		
Towel/handkerchief sharing	40 (90.9)	15 (71.4)	4.40*	11.5	(1.2-112.1)
Washcloth sharing	31 (70.5)	17 (81.0)	0.31		
Comb sharing	31 (70.5)	15 (71.4)	0.40		
Toothbrush sharing	2 (4.7)	0 (0.0)	1.29		
Spoon/chopsticks sharing	19 (43.2)	10 (47.6)	0.28		
Cup/glass sharing	44 (100.0)	18 (85.7)	4.47*	12.1	(0.7-202.0)
Stew served in one bowl (eaten communally)	44 (100.0)	19 (90.5)	2.47		
Kimchi served in one bowl (eaten communally)	44 (100.0)	20 (95.2)	1.50		
Water Kimchi served in one bowl (eaten communally)	44 (100.0)	20 (95.2)	1.50		
Fish/pickled fish served in one bowl (eaten communally)	44 (100.0)	20 (95.2)	1.50		

a) Positive for at least one HBV marker (HBsAg, anti-HBs or anti-HBc)
b) Adjusted for age, prior operation and tooth extraction
c) Mantel-Haenszel estimates adjusted for age, prior operation and tooth extraction
d) The household contacts of carrier without response to family life behavior (6 cases) excluded
* $P < 0.05$ (x^2 test)

positive for HBV infection (P<0.05), with RR of 10.1 (95% CI; 1.1-97.0). Daughters of carriers also had a higher rate of HBV infection than daughters of controls (45.5% vs 20.0%), but this was not statistically significant (P>0.05)(Table 3).

Past medical histories associated with HBV infection

The household contacts of carriers and controls without HB vaccination had very similar experiences of past medical histories except for acupuncture use. Household contacts of controls had a higher proportion, 47.1% of acupuncture use history than those of carriers, 16.9%. Comparing infected and non-infected household contacts of carriers(Table 4), the proportion who had histories of surgical operations was significantly higher among infected contacts (38%) than among non-infected (4.8%, RR of 12.3 with 95% CI; 1.5-98.9). And the infected have more experience of dental procedures (50%) than the non-infected (23.8%, RR of 3.2 with 95% CI; 1.0-10.1).

Similar findings for past medical histories were observed in the household contacts of controls (Table 4).

The combined odds ratios of prior operation and tooth extraction for the HBV infection among the total households without HB vaccination were 6.5 (95% CI; 2.2-18.9) and 2.5 (95% CI; 1.1-5.5), respectively

Risk factors associated with household transmission of HBV infection.

We examined the possible modes of household transmission of HBV infection by comparing infected with non-infected contacts of carriers. Adjusted for age, history of surgical operations and dental procedures in the analysis, sharing of towels or handkerchieves and sharing of drinking vessels with the carrier in home incurred an increased risk of HBV infection with RRs of 11.5(95% CI; 1.2-112.1) and 12.1(95% CI; 0.7-202.0) respectively. Other modes such as sharing of bedrooms, bedding, washcloths, combs, toothbrushes, eating utensils, and the eating together of food served in one dish were not associated with an increased risk of HBV transmission in Korea(Table 5).

DISCUSSION

Whether our HBsAg positive carriers group and susceptibles group adequately represent the source populations an issue which must be examined before any meaningful conclusions can be reached. By selecting the index cases of carriers and susceptibles to HBV infection from a group of government employees, school teachers and staff living in a defined residential area who are assigned to two hospitals for their free biannual health screening, we sampled a community population rather than a self selected patient population. And as the cases of chronic carriers and controls were also selected only when they were confirmed by serological test results, both of them should adequately represent the source population. While the rate of response to study participation was not high both in case(38%) and control(25%) groups. We did not fully compare the non-responders in each group. However, as seen in Table 1, no significant differences exist between the two groups with respect to demographic and other general characteristics. As such, these groups are validly comparable to each other.

Familial clustering of HBV infection is well known. HBsAg prevalence among the household contacts of acute cases of hepatitis B was 3.3 times higher than that of the general population (Goh et al., 1985). Prevalence of HBsAg and each of all HBV markers among the household contacts of chronic carriers were 6.8 and 3.4 times higher than those of household contacts of controls respectively(Bernier et al., 1982). Mother to child transmission has been well documented in Hong Kong(Lok et al., 1987) and Taiwan(Stevens et al., 1975). Father to child transmission(Szmuness et al., 1973), transmission among siblings(Kashiwagi et al., 1984; Toukan et al., 1990), and transmission among spouses(Szmuness et al., 1975) have also been documented.

Our study showed the household transmission of HBV infection, especially from parents to offsprings when one of the parents was a carrier, which resulted in familial clustering. The prevalence of HBV infection among the offspring of carriers was as high as 6.6 times higher than that of controls. When the offspring were further divided by sex, a significant difference in HBV infection rate was seen among male offspring but not among female offspring. While, we have no sufficient evidence for an explanation at the moment, the number of female HBV infected offspring in this study may have been too small to yield a significant result. Further studies are necessary to clarify this difference in HBV infection among the offspring of chronic HBV carriers between genders.

The HBV infection rate of the spouses of carriers did not differ from that of the spouses of controls. This is consistent with the findings of Lok et al., who studied a population with a high prevalence of HBV infection(Lok et al., 1987). However, this conflicts with the findings of Szmuness et al, who studied a population with a low prevalence of HBV infection and found a 2.5 relative risk among the spouses of carriers(Szmuness et al., 1975). In Korea, the HBV infection rate among persons in their 20's is estimated at 59-73%(Ahn et al., 1992), most of the spouses of the carriers may have already been infected with HBV prior to marriage with relative reduction of the risk of new infection from HBV carrier after marriage.

Parents, siblings, and other relatives of carriers and controls also did not differ in the HBV infection rate in our study. Most of them were adults who have a high prevalence of HBV infection in Korea (Ahn et al., 1992). And also, the sample size is too small to conclude. A larger study where more parents, siblings and other relatives are included should be done.

Two main routes of HBV transmission are parenteral and nonparenteral. Parenteral routes which are considered to have great impact currently are occupational percutaneous exposure, needle exposure among drug addicts, repeated transfusion and other medical exposures. In comparing the HBV infected household contacts of carriers to those not infected with HBV, operations and frequent dental procedures were identified as significant risk factors for transmission of HBV, unrelated to household contact. Although not statistically significant, HBV infection rate was higher in those who had had prior endoscopy. This may suggest a possible increase in iatrogenic transmission of HBV in the future with the increase in endoscopic procedures(Hwang et al., 1981). Too few subjects in our study had transfusions, tatoos or contact with hepatitis patients outside the household for adequate comparison. Nonparenteral routes considered to have the greatest impact are intimate contacts and perinatal transmission(Heathcote et al., 1974; Scott et al., 1980; Lee et al., 1978; Gerety et al., 1977). In order to evaluate the specific types of intimate contacts, all the factors associated with percutaneous and perinatal transmission should be controlled. The above three significant risk factors (age, operations and frequent dental procedures) were controlled in our stratified analysis of nonparenteral transmission in household contacts as confounding variables.

Factors related to intrafamilial transmission were the sharing of personal or household articles, exposure to the body fluid of carriers and sex related factors among spouses of carriers(Bernier et al., 1982). Factors associated with the risk of HBV infection included sharing of various household articles such as toothbrushes, towels, handkerchieves, clothing, razors, combs, beds, bedding, and washcloths(Goh et al., 1985; Bernier et al., 1982). Factors associated with exposure to body fluid were contacts of carriers who had skin sores and who bit their nails. No specific sex related factors were identified among spouses of carriers such as the number of years they had lived with a carrier, frequency of intercourse, oral-genital contact, or use of condoms(Bernier et al., 1982).

In this study the sharing of towels and handkerchieves being identified as a significant mode of transmission of HBV through household contact, reaffirmed the possibility of the spread of HBV through towels and handkerchieves contaminated with the blood, saliva or other body fluids of HBV carriers. This is consistent with studies by Goh et al(Goh et al., 1985) and Bernier et al(Bernier et al., 1982) where the possibility of HBV spread through towels, handkerchiefs and washcloths was shown. Although the sharing of cups or wineglasses turned out to be a possible risk factor, when the confidence interval is considered (0.7-202.0) which includes 1.0, this may not be as significant a risk factor as the sharing of towels and handkerchieves. Even though this suggests the possibility of the spread of HBV through cups or wineglasses contaminated with the saliva of HBV carriers, Goh et al.(Goh et al., 1985) and Bernier(Bernier et al., 1982) found no increased risk in this behavior. However, when this behavior is viewed within the context of the traditional Korean custom of drinking from the same cup or wine glass one after another among those sitting at a table, this is worthy of consideration as a possible risk factor in Korea and deserves further study in the future.

The sharing of bedrooms did not turn out to be a risk factor for the spread of HBV and supports the lack of danger of the spread of HBV in the absence of direct contact. Thus, it is unreasonable to advocate isolation measures such as HBsAg carriers using a separate bedroom from the rest of the household. This finding also supports the fact that simple sharing of bedrooms in the military or in dormitories is not a risk factor. Sharing of bedding also did not turn out to be a risk factor. This is applicable mainly to cases where the household con-

tacts of carriers are spouses and can be explained by the same rationale for the lack of significant difference in infection rate among spouses of controls and carriers.

Sharing of washcloths, combs, razors, toothbrushes and shoes were not risk factors. Even though the sharing of a razor between father and son or among brothers is commonly observed, such sharing did not occur in our study sample frequently enough for adequate comparison. Ahn et al. had found the sharing of toothbrushes to be a risk factor for the nonparenteral spread of HBV (Ahn et al., 1987). But, with the rising standard of living and enhancement of health habits, few share toothbrushes anymore and so this could not be adequately studied.

The sharing of eating utensils, rice bowls and soup bowls, among a carrier's household did not increase the risk of HBV infection, in agreement with findings by Goh et al(Goh et al., 1985). This suggests that it is almost impossible to transmit HBV from a carrier to other members of the household without a break in the oral mucosa through contaminated eating utensils or food. Consequently, it is not necessary to use separate dishes and eating utensils for HBsAg carriers in a household. When the sharing of various foods from the same dish was examined for the possibility of increased spread of HBV infection from carriers to household contacts all the foods studied were unrelated to the spread of HBV infection. However, as almost all members (more than 85%) of our study sample share foods served in one dish, whether in the control group or carrier group, analyses of this factor may not be specific.

The risk factors shown in this study need to be evaluated in the context of a particular population's customs. Usually in Korea, when towels or cups are shared within a household they are not laundered or washed after single use but several members of the household share the item at the same time. This increases the opportunity for direct contact between skin or mucosal membrane and allows these activities to transmit HBV. Bowls and dishes are washed after each use, decreasing the possibility of direct contact. Even when bed, bedding and shoes, etc are shared, the chance of direct skin contact is very low. The sharing of washcloths occurs very infrequently compared to towels. Even when shared, it is usually washed between users even when several household members share the washcloth at the same time. Thus, it can be concluded that important risk factors for the nonparenteral transmission of HBV are first, direct contact between skin or mucosal membrane and secondly, limited to chance of exposure to such direct contact.

In order to prevent the spread of HBV infection to the household contacts of carriers where no adequate treatment for chronic hepatitis B exists, health education based on clear epidemiological evidence is necessary. We must avoid causing undue anxiety or unnecessary isolation measures for HBsAg carriers and their household contacts based on misconceptions. Public health education to enhance practice of correct personal hygiene such as frequent hand washing and exercising special precaution when handling or disposing of blood or blood contaminated items is elementary. Also recommended, based on our findings, is the avoidance of the sharing of towels and handkerchieves and the avoidance of the sharing of cups or wineglasses. Furthermore, all those at high risk of HBV infection such as the household contacts of HBsAg carriers should be advised to receive HB vaccination.

REFERENCES

Ahn YO, Kim CY, Hiyama T, Tsukuma H, Shigematsu T, Kono S : *Liver Cancer among Koreans in Japan and Korea, Epidemiology & Prevention of Cancer, The proceedings of Munvusho 1989 International Symposium on Comparative Study of Etiology & Prevention of Cancer. The University of Nagoya Press, Nagoya, Japan. 177-184, 1990.*

Ahn YO, Kim YS, Lee MS, Shin MH : *Hepatitis B Virus Infection Rate among Koreans. Seoul J Med. 33 : 105-114, 1992.*

Ahn YO, Park BJ, Yoo KY, Kim CY, Shigematsu T : *Incidence estimation of primary liver cancer among Koreans. J Korean Cancer Assoc. 21 : 241-248, 1989.*

Ahn YO, Yoo KY, Park BJ : *An epidemiologic study on risk factors of hepatitis B infection in Korea. Korean J Epidemiol. 9 : 57-65, 1987.*

Bernier RH, Sampliner R, Gerety R, Tabor E, Hamilton F, Nathanson N : *Hepatitis B infection in households of chronic carriers of hepatitis B surface antigen : factors associated with prevalence of infection. Am J Epidemiol. 166 : 199-211, 1982.*

Gerety RJ, Bethesda MD, Schweitzer IL : *Viral hepatitis type B during pregnancy, the neonatal period and infancy. J Ped. 90 : 368, 1977.*

Goh KT, Ding JL, Monteiro EH, Oon CJ : *Hepatitis B infection in households of acute cases. J Epidemiol Community Health. 39 : 123-128, 1985.*

Hann HWL, Kim CY, London WT, Whitpid P, Blumberg BS : *Hepatitis B virus and primary hepatocellular carcinoma, family studies in Korea. Int J Cancer 30 : 47-51, 1982.*

Heathcote J, Gateau PH, Sherlock S, et al : *Role of hepatitis B antigen carriers in nonparenteral transmission of the hepatitis-B virus. Lancet. 17 : 370-371, 1974.*

Hwang YS, Yang US, Liu BH : *HBsAg positivity in adherent juices of fiberoptic endoscope, gastric juices, saliva which were collected during endoscopy in serum HBsAg positive cases. J Korean Med Assoc. 24 : 605-609, 1981.*

Kashiwagi S, Hayashi J, Ikematsu H,et al : *Transmission of hepatitis B virus among siblings. Am J Epidemiol. 120 : 617-625, 1984.*

Kashiwagi S, Hayashi J, Nomura H, et al : *Changing pattern of intrafamilial transmission of hepatitis B virus in Okinawa, Japan. Am J Epidemiol. 127 : 783-787, 1988.*

Korea Medical Insurance Corporation : *'90 Medical Insurance Statistical Yearbook. 1991 Seoul, Korea. 402.*

Lee AKY, Ip HMH, Wong VCW : *Mechanism of maternal-fetal transmission of hepatitis B virus. Inf Dis. 138 : 668-671, 1978.*

Lee HS, Byun JH, Kim CY : *Etiology and outcome of acute viral hepatitis in Korean adults. J Kor Med Sci. 5 : 149-154, 1990.*

Lok ASF, La CL, Wu PC, et al : *Hepatitis B virus infection in Chinese families in Hong Kong. Am J Epidemiol. 126 : 492-499, 1987.*

Scott RM, Snitbhan R, Bancroft WH, et al : *Experimental transmission of hepatitis B virus by semen and saliva. J Inf Dis. 142 : 67-71, 1980.*

Stevens CE, Beasley RP, Tsui J, et al : *Vertical transmission of hepatitis B antigen in Taiwan. N Engl J Med. 292 : 771-774, 1975.*

Szmuness W, Much IM, Prince AM, et al : *On the role of sexual behavior in the spread of hepatitis B infection. Ann Intern Med. 83 : 489-495, 1975.*

Szmuness W, Prince AM, Hirsch RL, et al : *Familial clustering of hepatitis B infection. N Engl J Med. 289 : 1162-1166, 1973.*

Toukan AU, Sharaiha ZK, Abu-el-Rub OA, et al : *The epidemiology of hepatitis B virus among family members in the Middle East. Am J Epidemiol. 132 : 220-232, 1990.*

Yoo KY, Kim H, Lee MS, et al : *A Reconstructed Cohort Study on the Hepatitis B Virus Infection as a Risk Factor of Liver Cancer in Korea. J Kor Med Sci. 6 : 319-324, 1991.*

Yoo KY, Park BJ, Ahn HS, et al : *Incidence rate of hepatitis B ; results of a record linkage study among healthy Korean males. J Kor Med Sci. 5 : 179-183, 1990.*