Seasonal Trends in the Incidence of Hip Osteoarthritis in Japanese Patients

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Abstract: *Purpose*: There is an association between winter birth and developmental dysplasia of the hip, formerly termed congenital dislocation of the hip. The purpose of this study was to clarify the relationship between the month and season of birth and hip osteoarthritis in Japanese patients who had undergone total hip arthroplasty or transpositional osteotomy of the acetabulum.

Methods: One thousand eight hundred and 52 female patients that presented for the surgical treatment of hip osteoarthritis between 1999 and 2005 were included in this study. Female out-patients who were seen at the initial visit during same period were used as controls to correct the bias of the month of birth.

Results: There was a significant deviation of the observed number of births from the expected values calculated on a monthly basis ($p<0.001$). A comparison by seasons (periods of 3 months) revealed more births than expected in winter ($p<0.001$). The risk of hip osteoarthritis was significantly associated with the month of birth. Namely, it was highest for births in January ($p<0.001$).

Conclusions: These data clearly revealed that the prevalence of hip osteoarthritis was significantly higher in those patients born in winter. The seasonal trend in hip osteoarthritis might be due to the winter prevalence of congenital dislocation of the hip in childhood.

Keywords: Seasonal trend, hip, osteoarthritis, acetabular dysplasia, Japanese.

INTRODUCTION

Hip osteoarthritis is an important cause of musculoskeletal disability. Epidemiological studies suggest that hip osteoarthritis has a multifactorial etiology and have identified several contributory risk factors [1], including increasing age, obesity, trauma, and occupational physical activity. In addition, clinical studies on hip osteoarthritis suggest that structural abnormalities of the hip that are present at delivery or develop in childhood may result in accelerated or premature joint degeneration [2]. Developmental dysplasia of the hip (DDH), formerly termed congenital dislocation of the hip (CDH), refers to a spectrum of anatomical abnormalities of the hip joint arising from a deviation in normal hip development during embryonic, fetal, and infantile growth periods [3]. Although, this problem normally resolves spontaneously within the first few months of life in most affected infants, persistent DDH can result in acetabular dysplasia followed by hip osteoarthritis. More than 70% of the cases of hip osteoarthritis in Japan are associated with acetabular dysplasia [4].

Clinical and epidemiological studies on DDH have been conducted. A greater number of subjects with DDH are born during winter than during warmer periods [5, 6]. However, the incidence of hip osteoarthritis among patients born in different seasons has not been documented. Hip osteoarthritis and seasonal factors must also be related if there is a relationship between DDH and seasonal factors. The purpose of this study was to clarify the relationship between hip osteoarthritis and the month of birth in Japanese patients, using data from a hospital-based case control study. The study also addressed whether the season of birth affected the risk of hip osteoarthritis.

The study protocol adhered to the ethical guidelines of the 1975 Declaration of Helsinki, and the study was approved by the institutional review board of the Faculty of Medicine, Saga University at Saga.

MATERIALS AND METHODOLOGY

Two thousand two hundred sixteen patients (1,895 female, 321 male) underwent surgery for hip osteoarthritis between January 1999 and December 2005. Patients with hip osteoarthritis caused by idiopathic osteonecrosis (n = 86), post-traumatic osteoarthritis (n = 33), Perthes' disease (n = 10), septic arthritis (n = 18), and systemic disease (n = 11) were excluded from this study. The remaining 2058 patients (1852 female, 206 male) were recruited. Finally, 1852 female patients with hip osteoarthritis were enrolled in this study.

The average age at the time of the operation was 56.8 years old (range, 11-85 years old). One thousand five hundred eighteen patients underwent total hip arthroplasty (THA), and 339 patients underwent transpositional osteo-

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tomy of the acetabulum (TOA). The average age at the time of THA was 61.4 years old (range, 31-95 years old), and the average age at the time of TOA was 37.4 years old (range, 11-56 years old).

Hip osteoarthritis was classified into categories ranging from early- to terminal-stage disease on the basis of radiological observations. The early stage was characterized by a slight narrowing of the joint space; this was associated with sclerosis of the subchondral bone. The advanced stage was characterized by an obvious narrowing of the joint space, with some cystic changes and the presence of small osteophytes in the femoral head and/or the acetabulum. The terminal stage was characterized by the disappearance of the joint space with marked osteophyte exposure. Hip osteoarthritis secondary to DDH was defined as a center-edge angle < 20 degrees and an acetabular head index < 75% [7].

Transpositional osteotomy of the acetabulum (TOA) was performed on the patients who were in the early stage and on some patients in the advanced stages of osteoarthritis and with evident DDH [8]. The indication for TOA was limited to the patients under 56years of age in our institution. Total hip arthroplasty (THA) was performed on the patients in the terminal stage and on some patients in the advanced stages.

Monthly data of the people who did not undergo THA or TOA were obtained from and institutional database for comparison. The observed number of births in the current sample was compared with expected values calculated from 37746 female patients who were seen at the outpatient clinic during the initial visit between January 1999 and December 2005.

The year was divided based on the mean lowest air temperature of the month in Tokyo. December (4.6°C), January (2.1°C), and February (2.4°C) that have the lowest mean air temperature were established as the winter period. Spring, summer, and autumn were defined as; spring (March (5.1°C), April (10.5°C), and May (15.1°C), summer (June (18.9°C), July (22.5°C), and August (24.2°C), autumn (September (20.7°C), October (15.0°C), and November (9.5°C)).

The statistical package for social sciences (SPSS)version 12.0J for Windows (SPSS Inc., Chicago, IL, USA) was used for the statistical analysis using the χ^2 test and one-way analysis of variance (ANOVA) with the Tukey. (*n)* refers to the number of patients in all cases. The level of significance was set at $p < 0.05$.

RESULTS

Fig. (**1**) shows the observed and expected percentage of births for each month. An analysis of the data indicates that there was a significant deviation of the observed number of births from the expected values calculated on monthly basis (χ^2=465.1, df=11, p<0.001; Fig. **1**). A comparison of seasons (Fig. **2**), revealed more births than expected in winter (+18.0%) (χ^2=376.5, df=3, p<0.001).

Table **1** shows the seasonal trend after adjusting for the birth dates of expected values, of hip osteoarthritis in all subjects. The maximum overall OR was 6.5 (95% CI: 4.7–9.1) for the month of January. The second highest OR was 6.3 (95% CI: 4.5–8.9) for February. There was no significant difference in the mean age of those born during each month in each group (p=0.219).

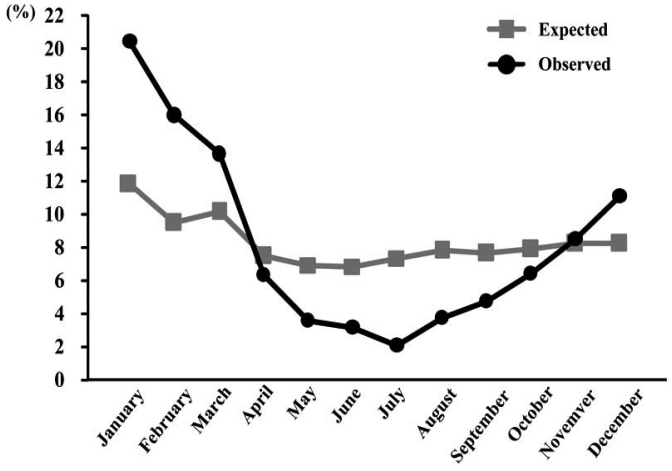

Fig. (1). Observed and expected percentage of births for each month. χ^2=465.1, df=11, p<0.001.

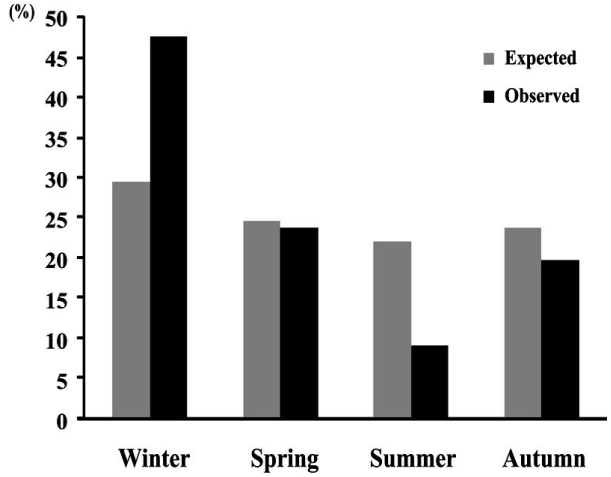

Fig. (2). Observed and expected percentage of births for each season. χ^2=376.5, df=3, p<0.001.

DISCUSSION

The present report is the first to demonstrate that the season of birth may influence the risk of hip osteoarthritis. Congenital and infant stage abnormalities that result in abnormal load distributions within the joint, such as DDH, Perthes' disease, and slipped capital femoral epiphysis of the hip, are associated with a very high risk of subsequent development of osteoarthritis in the affected joint [9].

DDH was examined in the current study, because over 70% of hip osteoarthritis due to DDH in Japan. Several countries have reported an association between the season of birth and the risk of DDH. However, the results were somewhat different. More DDH patients were born during the winter months in Hungary [10]. Robinson [11] reported 2 peaks, the first in February–March and the second in August–December. Cyvin [12] discovered a higher incidence of DDH in neonatal girls born in September–October. The number of DDH patients born during winter was higher than expected in Japan [6], and this could explain the association between birth in winter and the risk of hip osteoarthritis

Table 1. Odds Ratios and 95% Confidence Intervals in Each Month

Month	Number of Patients (THA/TOA)	Age (Mean±SD)	Outpatients	Age (Mean±SD)	Odds Ratio	95% Confidence Interval		P-Value
1	379(319/60)	56.0±11.9	4089	44.8±25.7	6.502	4.660	9.073	<0.001
2	296(255/41)	57.9±13.3	3284	43.3±25.8	6.323	4.511	8.864	<0.001
3	253(213/40)	57.9±13.3	3584	44.1±26.9	4.952	3.522	6.963	<0.001
4	118(91/27)	55.8±12.9	2707	36.6±24.9	3.058	2.121	4.409	<0.001
5	67(48/19)	56.4±16.6	2552	36.2±25.6	1.842	1.237	2.743	0.002
6	59(42/17)	56.5±16.0	2534	35.1±25.6	1.633	1.086	2.457	0.017
7	39(34/5)	59.6±15.0	2736	35.4±25.8	1.0			
8	70(54/16)	56.8±14.7	2881	38.6±25.9	1.705	1.148	2.530	0.007
9	88(68/20)	57.2±12.1	2792	36.2±25.9	2.211	1.511	3.236	<0.001
10	119(91/28)	55.7±13.6	2872	38.7±26.2	2.907	2.017	4.189	<0.001
11	158(133/25)	58.2±12.1	2956	38.5±26.1	3.750	2.631	5.344	<0.001
12	206(165/41)	54.6±12.3	2907	37.8±25.4	4.971	3.516	7.028	<0.001

demonstrated in this study. The current study found that the overall OR for the risk of hip osteoarthritis was 6.5 for January comparison to July.

Animal studies show that dislocation and subluxation of the development of the hip in a young rat by application of splints reaching from the hip to the foot brings the hip into extension [13]. Postnatal hip position affects the incidence of DDH, and the position is generally decided by the culture. The observation that the cultural groups in which the children are carried on the hips with their legs flexed and abducted have a low incidence of dislocation provides evidence supporting the importance of the postnatal position of the limbs. Infants in Thailand are reared unclothed and without using any diapers because of the hot climate, and the incidence of CDH is only 0.05% [14]. Conversely, there is a correspondingly high incidence of dislocation in those groups in which the infants' legs are held together (e.g., Native American) [15]. Infants used to have their legs wrapped in a diaper and additional clothing after birth in Japan [16]. Most of Japan has a temperate climate with four distinct seasons, and the mean temperature difference between summer and winter is around 20 degrees. Therefore, it is inferable that the use of clothing and bedding is heavier during the winter than summer in Japan, thus suggesting that DDH is associated with the season of birth.

The current study found that the highest OR was 6.5 (95% CI: 4.7-9.1) for the month of January, and the percentage of births is also the highest in winter period. Therefore, the seasonal trend of hip osteoarthritis was affected by the seasonal trend of DDH.

Many diseases show a seasonal trend of incidence. For example, there is a seasonal variation in the risk of cancer including acute lymphoblastic leukemia in children [17], early-onset Hodgkin lymphoma [18], breast cancer [19], Schizophrenia [20], bipolar disorder [21], Alzheimer [22], multiple sclerosis [23], and stroke [24]. However, there are few reports that show a seasonal trend of secondary disease due to diseases of the newborn. Therefore, this report is unique and the first report to address the seasonal trend in the prevalence of DDH and hip osteoarthritis

CONCLUSION

These data clearly revealed a significantly high prevalence of hip osteoarthritis in the Japanese patients born during winter. The seasonal trend in hip osteoarthritis might be due to the winter prevalence of congenital dislocation of the hip in childhood. Therefore, the above findings indicated that birth in winter can contribute to the risk of hip osteoarthritis in Japan.

CONFLICT OF INTEREST

The authors did not receive and will not receive any benefits or funding from any commercial party related directly or indirectly to the subject of this article.

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REFERENCES

[1] Tepper S, Hochberg MC. Factors associated with hip osteoarthritis: data from the First National Hearth and Nutrition Survey (NHANES-I). Am J Epidemiol 1993; 137(10): 1081-8.

[2] Harris WH. Etiology of osteoarthritis of the hip. Clin Orthop Relat Res 1986; (213): 20-33.

[3] Hadlow V. Neonatal screening for congenital dislocation of the hip. A prospective 21-year survey. J Bone Joint Surg Br 1988; 70(5): 740-3.

[4] Kobayashi S, Eftekhar NS, Terayama K, Iorio R, Takaoka K. Primary Charnley total hip arthroplasty: a comparison of American and Japanese cohorts followed for 10-20 years. J Arthroplasty 2001; 16(3): 340-50.

[5] Chen R, Weissman SL, Salama R, Klingberg MA. Congenital dislocation of the hip (CDH) and seasonality: The gestational age of vulnerability to same seasonal factor. Am J Epidemiol 1970; 92(5): 287-93.

[6] Nagura S. Etiology of congenital hip dislocation. Zentralbl Chir 1955; 80(48): 1933-43.

[7] Nagasawa F, Miyake Y, Akazawa H, *et al*. Predictability of the progress of secondary osteoarthritis after developmental dislocation of the hip, utilizing inferior edge (of the teardrop) – center (of the femoral head) distance. J Orthop Sci 2000; 5(1): 10-7.
[8] Ninomiya S. Rotational acetabular osteotomy for the severely dysplastic hip in the adolescent and adult. Clin Orthop Relat Res 1989; (247): 127-37.
[9] Amstutz HC, Su EP, Le Duff MJ. Surface arthroplasty in young patients with hip arthritis secondary to childhood disorders. Orthop Clin North Am 2005; 36(2): 223-30.
[10] Pap K. Effect of seasons of the year on incidence of congenital hip dislocations. Zentralbl Chir 1956; 81(46): 2388-9.
[11] Robinson GW. Birth characteristics of children with congenital dislocation of the hip. Am J Epidemiol 1968; 87(2): 275-84.
[12] Cyvin KB. Congenital dislocation of the hip joint. Acta Paediatr Scand Suppl 1977; (263): 1-67.
[13] Sijbrandij S. Dislocation of the hip in young rats produced experimentally by prolonged extension. J Bone Joint Surg Br 1965; 47(4): 792-5.
[14] Limpaphayom M, Bhongsvej S, Chitinanda SP. Orthopaedic problem in the newborn. J Med Assoc Thai 1975; 58(7): 363-7.
[15] Pratt WB, Freiberger RH, Arnold WD. Untreated congenital hip dysplasia in the Navajo. Clin Orthop Relat Res 1982; (162): 69-77.
[16] Ishida K. Prevention of the development of the typical dislocation of the hip. Clin Orthop Relat Res 1977; (126): 167-9.
[17] Sorensen HT, Pedersen L, Olsen J, Rothman K. Seasonal variation in month of birth and diagnosis of early childhood acute lymphoblastic leukemia. JAMA 2001; 285(2): 168-9.
[18] Langagergaard V, Nørgård B, Mellemkjaer L, Pedersen L, Rothman KJ, Sørensen HT. Seasonal variation in month of birth and diagnosis in children and adolescents with Hodgkin disease and non-Hodgkin lymphoma. J Pediatr Hematol Oncol 2003; 25(7): 534-8.
[19] Kristoffersen S, Hartveit F. Is a woman's date of birth related to her risk of developing breast cancer? Oncol Rep 2000; 7(2): 245-7.
[20] Mortensen PB, Pedersen CB, Westergaard T, *et al*. Effects of family history and place and season of birth on the risk of schizophrenia. N Engl J Med 1999; 340(8): 603-8.
[21] Castrogiovanni P, Iapichino S, Pacchierotti C, Pieraccini F. Season of birth in psychiatry. A review. Neuropsychobiology 1998; 37(4): 175-81.
[22] Torrey EF, Miller J, Rawlings R, Yolken RH. Seasonal birth patterns of neurological disorders. Neuroepidemiology 2000; 19(4): 177-85.
[23] Templer DI, Trent NH, Spencer DA, *et al*. Season of birth in multiple sclerosis. Acta Neurol Scand 1992; 85(2): 107-9.
[24] Oberg AL, Ferguson JA, Mclntyre LM, Horner RD. Incidence of stroke and season of the year: evidence of an association. Am J Epidemiol 2000; 152(6): 558-64.

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