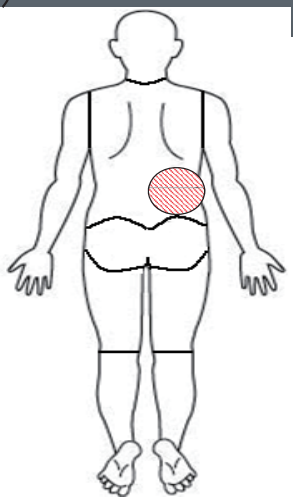
Materials & Methods

質問紙

- 基本情報（年齢・性別・身長・勤続年数・喫煙歴）

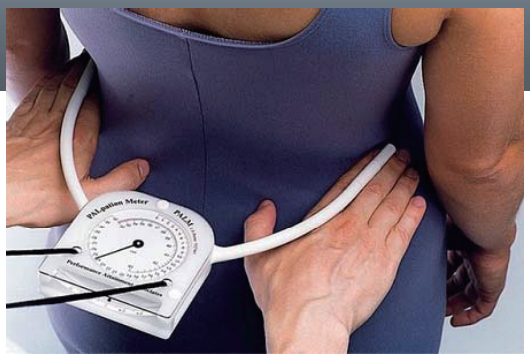
- 腰痛の有無
  - ✓ 期間：過去2週間（はい/いいえ）
  - ✓ 部位：肋骨最下端～臀溝の間の領域



- Self-reporting Depression Scale（以下、SDS）
  - ✓ 40点以上でうつ傾向あり

Materials & Methods

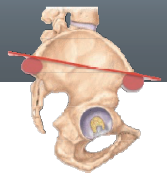
姿勢計測



検者内信頼性：0.78　（Palpation meterを使用）
検者間信頼性：0.76

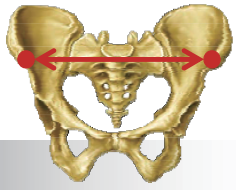
（Bruno RC, et al. ***Physiotherapy***. 2010）

- 前後傾斜角度（°）



- 左右傾斜角度（°）

- 骨盤の開き（cm）_前後



※体格の影響を除外するため、身長^2で補正

Materials & Methods

活動量（歩数）

- 入浴・睡眠・水に関わる活動以外のときは、基本的に常時着用

- 2週間の歩数データを平均し、代表値とした.

タニタ社製活動量計（FB-730）

2週間前　　計測日

平均値を算出

Statistical Analysis

単変量解析（2群間の比較）

腰痛の有無 ― ✓ 対応のないt検定
✓ カイ二乗検定

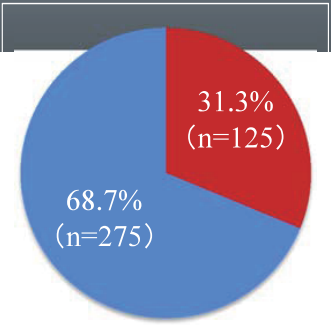
多変量解析（ロジスティック回帰分析）

- 従属変数：腰痛の有無
- 独立変数：単変量解析で有意差が認められた項目
- 調整変数：年齢

全ての解析は、男女別に行った.
統計学的有意水準は5%未満とした.

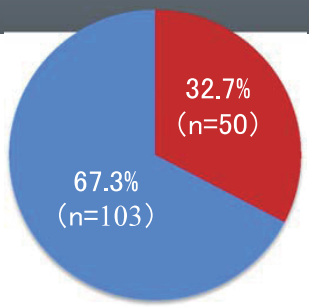
Results

男性



罹患率：31.3%

女性



罹患率：32.7%

Results

単変量解析

	男性			女性		
	なし群(n=275)	あり群(n=125)	P-value	なし群(n=103)	あり群(n=50)	P-value
基本情報						
年齢(歳)	45.9 ± 10.4	46.2 ± 9.9	0.760	39.9 ± 9.0	41.5 ± 8.4	0.291
BMI(kg/m²)	23.9 ± 3.2	25.2 ± 4.1	0.004*	21.6 ± 3.7	21.4 ± 3.1	0.730
勤続年数(year)	18.4 ± 10.8	18.2 ± 10.6	0.857	15.8 ± 10.2	14.7 ± 10.5	0.541
喫煙歴(有/無)	57.1%	62.9%	0.320	8.1%	14.0%	0.263
運動機能						
握力(kg)	45.2 ± 6.8	48.9 ± 39.8	0.310	27.6 ± 4.9	28.5 ± 4.9	0.492
30秒立ち上がり(回)	27.6 ± 5.8	27.2 ± 5.1	0.464	25.8 ± 5.9	25.3 ± 5.7	0.650
立位体前屈(cm)	-1.9 ± 9.9	-4.0 ± 9.5	0.050	4.6 ± 9.8	2.8 ± 6.8	0.244
片脚立位(sec)	35.9 ± 48.6	27.7 ± 37.9	0.096	29.3 ± 42.6	27.3 ± 41.3	0.780
姿勢計測						
骨盤傾斜_前後(°)	5.8 ± 3.2	6.0 ± 3.6	0.490	7.9 ± 4.3	8.6 ± 4.5	0.340
骨盤傾斜_左右(°)	-0.1 ± 1.5	-0.03 ± 1.1	0.586	0.3 ± 1.2	0.06 ± 1.3	0.322
骨盤の開き_前(cm)※	8.9 ± 0.9	9.0 ± 0.9	0.425	24.7 ± 2.0	24.8 ± 2.2	0.775
骨盤の開き_後(cm)※	2.8 ± 0.9	2.9 ± 0.9	0.256	9.0 ± 2.7	8.4 ± 3.2	0.227
精神機能						
うつ傾向の有無(≧40点)	39.1%	45.1%	0.269	42.4%	71.1%	0.002*
活動量						
歩数(steps/day)	8331.9 ± 2622.7	7861.9 ± 2840.9	0.186	7569.5 ± 2493.9	8042.8 ± 2750.9	0.401

※身長^2で補正　(*P< 0.01)

Results

多変量解析（ロジスティック回帰分析）

		Odds Ratio (95% CI)	P-value
男性	BMI	1.11 (1.03, 1.19)	0.007*
	年齢	1.00 (0.98, 1.03)	0.784
女性	うつ傾向	3.42 (1.59, 7.34)	0.002*
	年齢	1.02 (0.97, 1.06)	0.446

（*P< 0.01）

Discussion

男性

BMI

Odds ratio : 1.11

女性

うつ傾向

Odds ratio : 3.42

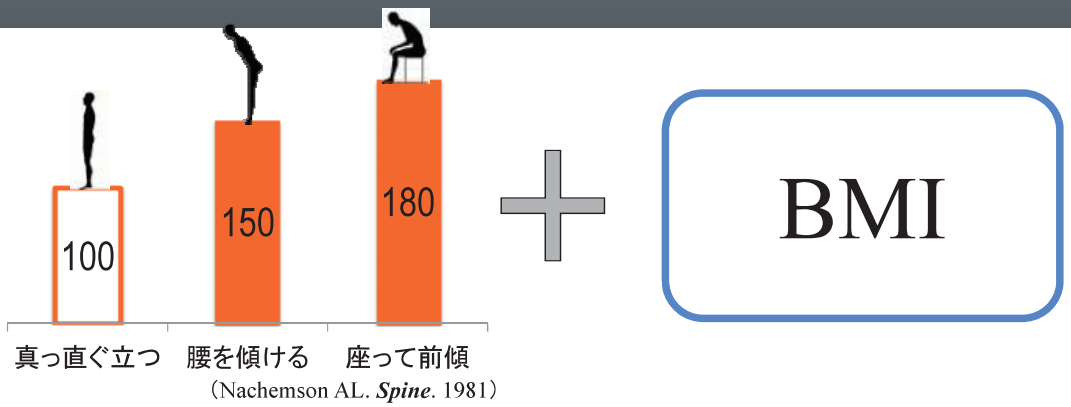
Discussion

腰痛 ー BMI

- 腰痛と体格に関する十分なエビデンスに基づく文献は存在しない.
  （Wai EK,et al. ***Spine J***. 2012）
- 男性の若年時の高BMIは、将来の腰椎椎間板障害に関連する.
  （Takatalo J, et al. ***BMC Musculoskelet Disod***. 2013）
- 高BMIは、腰痛発生、腰椎椎間板障害ともに関連する.
  （Dario AB, et al. ***Spine J***. **systematic review of twin studies**. 2015）

Discussion

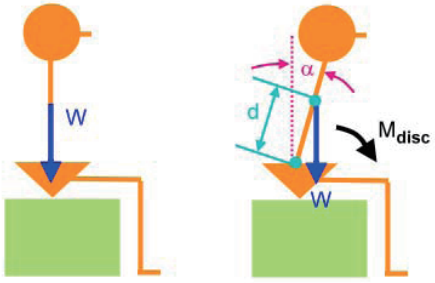
腰痛 ー BMI



（Nachemson AL. ***Spine***. 1981）

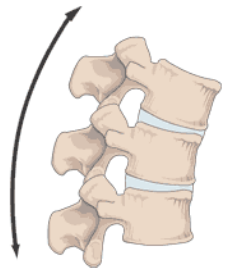
Discussion

腰痛 ー BMI



$M_{disc} = 0$　　$M_{disc} = Wd(\sin\alpha)$

（Chaffin D.B, et al. ***Occupational Biomechanics***. 1999）



椎間板の負荷↑
筋・筋膜の緊張↑

腰痛

Discussion

腰痛 ー うつ傾向

- 心理社会的要因は腰痛発生に関連する.

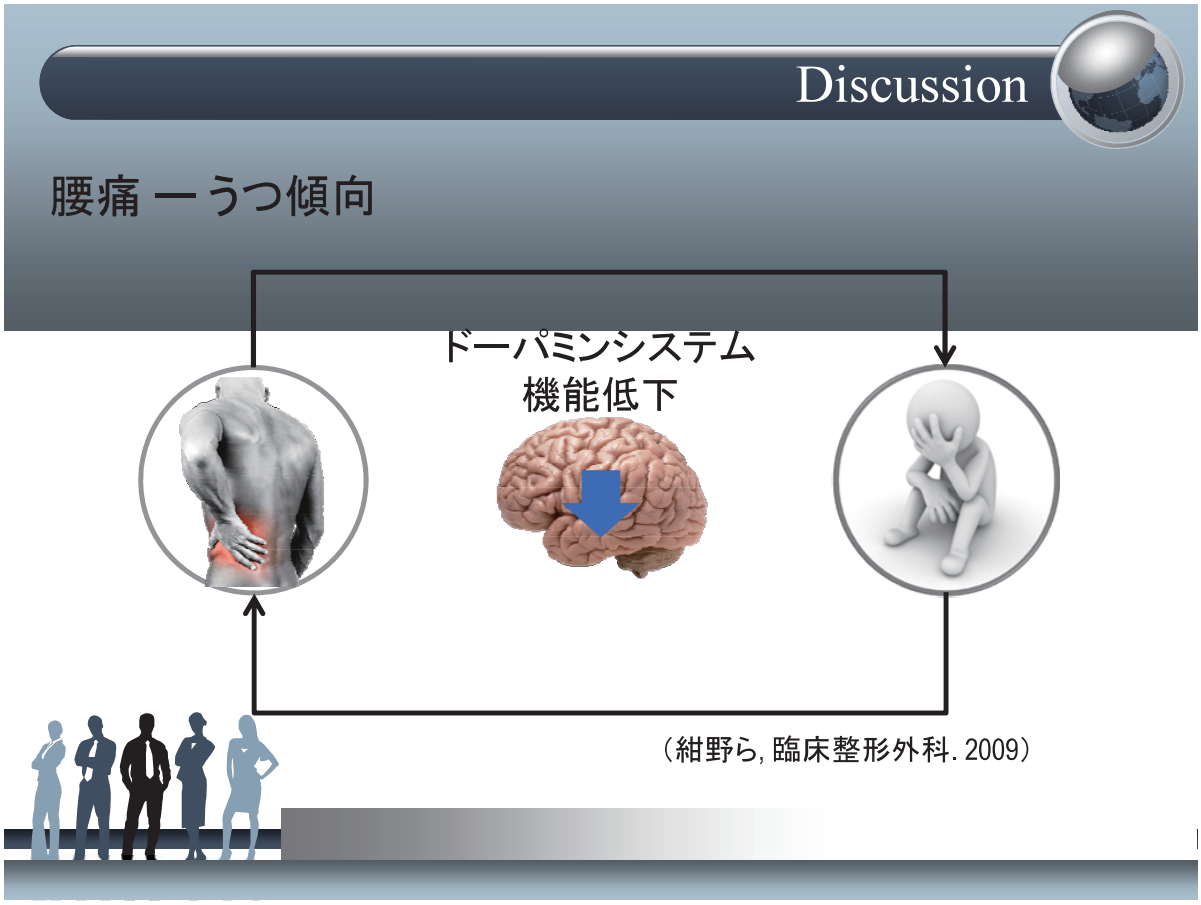
（Waddell G, et al. ***Occup Med***. 2001）

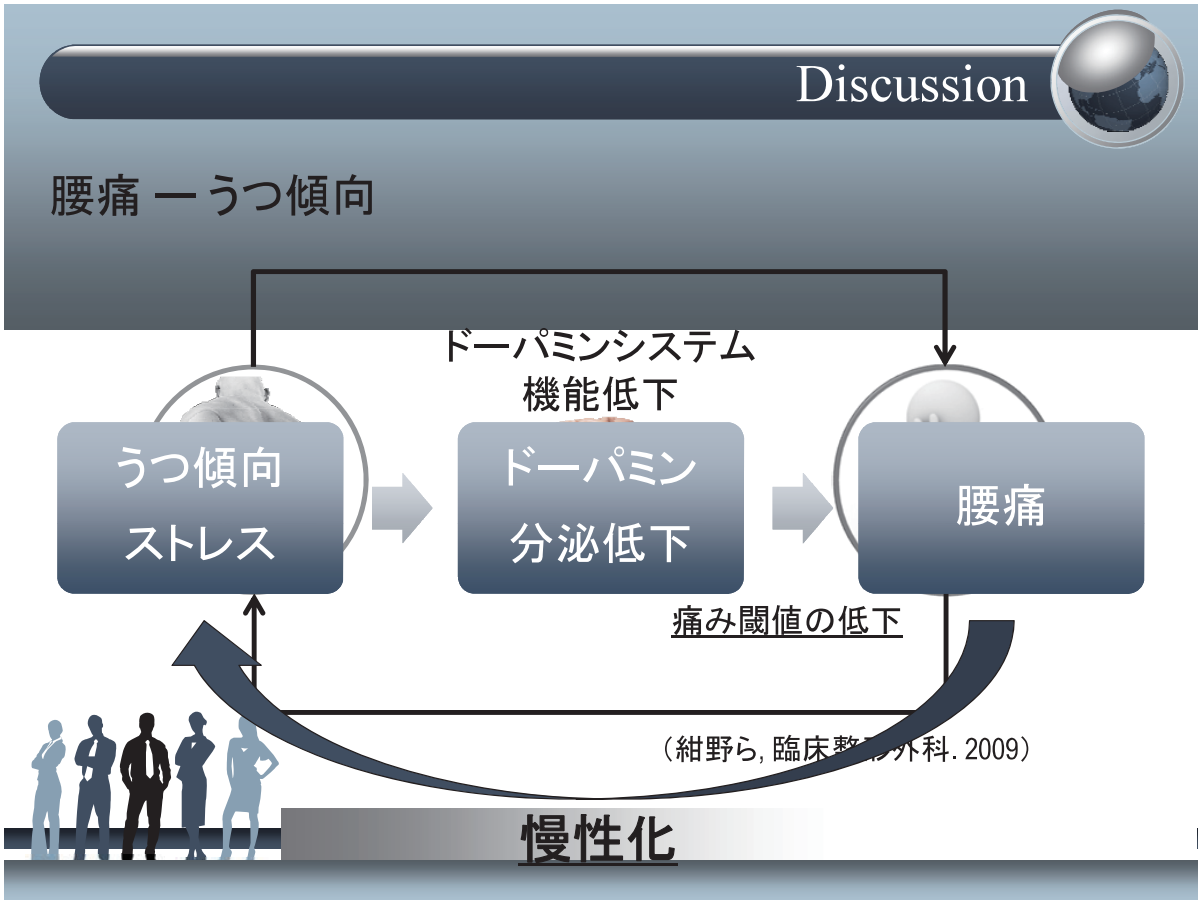
- 腰痛発生を予測する因子として、うつ病が最も影響度が強い.

（Currie SR,et al. ***Phychol Med***. 2005）

- 腰痛発生におけるうつ病のオッズ比は2.88である.

（Currie SR, et al. ***Phychol Med***. 2005）


Discussion
腰痛ーうつ傾向
ドーパミンシステム
機能低下
（紺野ら, 臨床整形外科. 2009）


Discussion
腰痛ーうつ傾向
ドーパミンシステム
機能低下
うつ傾向
ストレス
ドーパミン
分泌低下
腰痛
痛み閾値の低下
（紺野ら, 臨床整形外科. 2009）
慢性化

Conclusions

- オフィスワーカーにおける腰痛の罹患率は、男性で31.3%、女性で32.7%であった.
- 男性では、BMIが有意に腰痛の有無に関連していた.
- 女性では、うつ傾向が有意に腰痛の有無に関連していた.

Women's Health Care

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Research Article Open Access

The Association between Pregnancy-Related Discomforts and Pre-Pregnancy Body Mass Index in Japanese Women

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Abstract

Objective: To determine the association between pregnancy-related discomforts and pre-pregnancy body mass index in a longitudinal study.

Methods: The study included 355 pregnant women (age, 31.1 ± 4.1 years). Participants were divided into three groups according to their pre-pregnancy body mass index: the low body mass index group, normal body mass index group, and high body mass index group. The occurrence of pregnancy-related discomforts during the second and third trimesters was investigated. Binomial logistic regression analysis was used to examine the association between pre-pregnancy body mass index and pregnancy-related discomforts experienced during the last two trimesters.

Results: The occurrence of most pregnancy-related discomforts increased in the third trimester, while that of constipation and shoulder stiffness or headache decreased. Based on logistic regression analysis, pre-pregnancy body mass index was significantly associated with various discomforts. The occurrence of hip joint or pubis pain (odds ratio/95% confidence interval = 2.38/1.14–4.95) during the second trimester, and sleeping difficulty (2.00/1.09–3.67), hand or finger stiffness (3.00/1.36–6.45), leg cramps (2.29/1.32–3.98), low back pain (2.20/1.29–3.75), hip joint or pubis pain (2.14/1.23–3.73), and shoulder stiffness or headache (2.01/1.06–3.82) during the third trimester was significantly higher in the high body mass index group than in the normal body mass index group. The low body mass index group exhibited a significantly a higher occurrence of shoulder stiffness or headache (2.84/1.35–5.96) during the second trimester and constipation (2.28/1.08–4.82) during the third trimester than the normal body mass index group.

Conclusion: The occurrence of discomforts decreased or increased during pregnancy. Furthermore, both pre-pregnancy high and low body mass index represent important risk factors for many pregnancy-related discomforts, compared with a pre-pregnancy normal body mass index.

Keywords: Health promotion; Pregnancy; Pregnancy-related discomforts; Pre-Pregnancy BMI; Prevention

Introduction

Methods

Anatomical, physiological, hormonal, and psychological changes occur in woman during pregnancy [1,2], causing a variety of discomforts such as low back pain, ligament pain, fatigue, and headache [3]. These pregnancy-related discomforts negatively impact mother and child health and affect the quality of life and limit the daily activities of mothers [4,5]. Despite a number of researchers investigating the management of pregnancy-related discomforts [6,7], there are several limitations to the treatments available during pregnancy. For example, non-prescribed medicines are usually unsuitable because of their adverse effects on pregnant women themselves and on the developing fetus [8,9]. Therefore, a longitudinal study is necessary to collect information on the prevalence of discomforts through the stages of pregnancy. Such information will increase the knowledge of the measures that can be taken to protect women from pregnancy-related discomfort and will be essential to prevent their onset.

Before pregnancy, it is important for women to maintain an appropriate body mass index (BMI) to avoid hormone imbalance and its negative impact on fertility [10]. Furthermore, some research indicates that the pre-pregnancy BMI is a predicting factor for conditions such as gestational diabetes, and thus for adverse pregnancy outcomes [11,12]. Pre-pregnancy obesity may also be a modifiable risk factor for intellectual disability in children [13]. On the other hand, women with pre-pregnancy low weight are at an increased risk of intrauterine growth restriction, perineal tears, preterm birth (spontaneous and induced), and low birth weight [14,15]. These results suggest that both pre-pregnancy high and low BMI negatively

affect the progress of the pregnancy. Information about the occurrence of discomforts at each gestational period is necessary for their prevention. Moreover, a normal BMI before pregnancy promotes an uneventful progress through pregnancy. However, to date, very few studies have been conducted on the association between pre-pregnancy BMI and pregnancy-related discomforts. Accordingly, we conducted a longitudinal study aimed to identify pregnancy-related discomforts throughout pregnancy and to identify possible associations between these discomforts and the pre-pregnancy BMI.

Settings

We collected information from 355 women (age, 31.1 ± 4.1 years) at the obstetrics and gynecology clinics in the Aichi Prefecture, Japan, between 2009 and 2013. When the pregnant women visited the clinic for their periodic health examination, the information was collected by the hospital staff such as nurses. The inclusion criteria for the survey were the lack of serious orthopedic disorders, neurological diseases, and high-risk pregnancy. At the first medical examination, we recorded the personal information (age and BMI before pregnancy) of each participant by using a questionnaire.

Questionnaire about Pregnancy-Related Discomforts

The subjects of this study were asked to complete a questionnaire during the second trimester (22.4 ± 2.1 weeks of gestation) and third trimester (33.7 ± 2.1 weeks of gestation). We used the Medical Check Sheet to track pregnancy-related discomforts during gestation. The sheet, developed by the Japan Maternity Fitness Association, is a self-entry questionnaire for the management of physical conditions, to be completed before exercise. Questions were related to the expected date of birth, weeks of gestation, blood pressure, and 10 different pregnancy-related discomforts (i.e., sleeping difficulty, constipation, hand or finger stiffness, swelling, leg cramps, low back pain, hip joint or pubis pain, shoulder stiffness or headache, rib pain, and anorexia or heartburn), reported to commonly occur and to have an adverse effect on pregnancy. If the participants had felt discomfort due to any of the items on the list, those items were checked.

Ethical Considerations

After the purpose of the study had been explained, written informed consent was obtained from each participant in accordance with the guidelines approved by the Kyoto University Graduate School of Medicine and the Declaration of Human Rights, Helsinki, 1975. The protocol was approved by the Ethics Committee of Kyoto University Graduate School of Medicine (protocol approval E-2110).

Statistical Analyses

Participants were divided into three groups (low BMI group, normal BMI group, and high BMI group) according to their pre-pregnancy BMI (<18 kg/m^2, ≥18 kg/m^2, and <22 kg/m^2 or ≥22 kg/m^2, respectively). We statistically calculated the differences in age between these three groups using analysis of variance. Based on the Medical Check Sheet completed during the second and third trimester, we determined the occurrence of each symptom during the second and third trimesters and analyzed this using descriptive statistics. Binomial logistic regression analysis was used to examine the association between each discomfort and the pre-pregnancy BMI for each trimester. We referred to discomforts as the dependent variables, to low and high BMI groups as the independent variables (with the normal BMI group as reference), and to age as the adjustment variable. Data were entered and analyzed using the Statistical Package for the Social Sciences (Windows version 20.0; SPSS Inc., Chicago, IL, USA). For all analyses, $p<0.05$ was considered statistically significant.

Result

Information on 355 women (pre-pregnancy BMI= 20.3±2.1 kg/m^2) who met the inclusion criteria was collected. We assigned 37 women to the low BMI group (BMI= 17.4±0.6 kg/m2), 246 women to the normal BMI group (BMI= 19.8 ± 1.0 kg/m2), and 72 women to the high BMI group (BMI= 23.5±1.8 kg/m^2). There were no significant differences between the three groups (low, normal, and high BMI groups) in age (30.4 ± 4.2 years, 31.2 ± 4.0 years, and 31.2 ± 4.2 years, respectively).

The occurrence of most of the pregnancy-related discomforts analyzed increased from the second to third trimester, in contrast to that of constipation and shoulder stiffness or headache that showed a decrease (Figure 1).

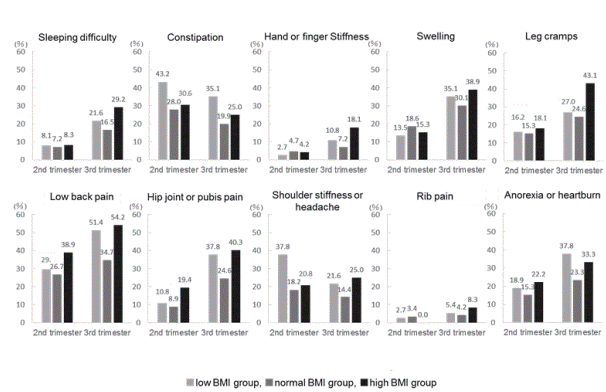

Figure 1: The prevalence of pregnancy-related discomforts during second and third trimester.

Multivariate analysis revealed that pre-pregnancy BMI was significantly associated with some of the discomforts during pregnancy (Table 1). The occurrence of hip joint or pubis pain (odds ratio/95% confidence interval=2.38/1.14–4.95) during the second trimester, and sleeping difficulty (2.00/1.09–3.67), hand or finger stiffness (3.00/1.36–6.45), leg cramps (2.29/1.32–3.98), low back pain (2.20/1.29–3.75), hip joint or pubis pain (2.14/1.23–3.73), and shoulder stiffness or headache (2.01/1.06–3.82) during the third trimester was significantly higher in the high BMI group than in the normal BMI group ($p<0.05$). The occurrence of shoulder stiffness or headache (2.84/1.35–5.96) during the second trimester, and constipation (2.28/1.08–4.82) during the third trimester was significantly higher in the low BMI group than in the normal BMI group ($p < 0.05$). No significant differences were observed in swelling, rib pain, and anorexia or heartburn.

Discussion

We analyzed the changes in the occurrence of pregnancy-related discomforts throughout pregnancy and whether their occurrence was significantly associated with pre-pregnancy BMI. We observed a different trend in the occurrence of the pregnancy-related discomforts

analyzed; in fact, while some of them tended to decrease, others appeared to increase during pregnancy progression. Furthermore, we found that both low and high BMI before pregnancy represent important risk factors for many pregnancy-related discomforts, compared with normal BMI.

		second trimester		second trimester	
Discomforts	**BMI group**	**Odds ratio**	**95%CI**	**Odds ratio**	**95% CI**
sleeping difficulty	**low BMI** **normal BMI** **high BMI**	1.13 1[reference] 1.15	0.32-4.01 0.44-3.02	1.32 1[reference] 2.00*	0.57-3.11 1.09-3.67
constipation	**low BMI** **normal BMI** **high BMI**	1.92 1[reference] 1.13	0.95-3.91 0.64-2.00	2.28* 1[reference] 1.38	1.80-4.82 0.74-2.56
hand or finger stiffness	**low BMI** **normal BMI** **high BMI**	0.6 1[reference] 0.93	0.08-4.81 0.25-3.43	1.61 1[reference] 2.97*	0.74-2.09 1.36-6.45
swelling	**low BMI** **normal BMI** **high BMI**	0.68 1[reference] 0.51	0.25-1084 0.38-1061	1.25 1[reference] 1.45	0.60-2.58 0.84-2.51
leg cramps	**low BMI** **normal BMI** **high BMI**	1 1[reference] 1.14	0..39-2.55 0.57-2.26	1.1 1[reference] 2.29*	0.50-2.40 1.32-3.98
low back pain	**low BMI** **normal BMI** **high BMI**	1.15 1[reference] 1.74	0.54-2.45 1.00-3.01	1.98 1[reference] 2.20*	0.99-3.98 1.29-3.75
hip joint or pubis pain	**low BMI** **normal BMI** **high BMI**	1.27 1[reference] 2.38*	0.41-3.94 1.14-4.95	1.95 1[reference] 2.14	0.94-4.03 1.23-3.73
shoulder stiffness or headache	**low BMI** **normal BMI** **high BMI**	2.84* 1[reference] 1.21	1.35-5.96 0.63-2.33	1.63 1[reference] 2.14	0.69-3.86 1.06-3.82
rib pain	**low BMI** **normal BMI** **high BMI**	0.83 1[reference] 0	0.10-6.86 0	1.32 1[reference] 2.14	0.28-6.31 1.06-3.82 0.75-6.11
anorexia or heartburn	**low BMI** **normal BMI** **high BMI**	1.24 1[reference] 1.56	0.51-3.03 0.81-3.01	1.97 1[reference] 1.62	0.95-4.08 1.06-3.82 0.92-2.87

Table1: The influence of pre-pregnancy BMI on pregnancy related discomforts (logistic regression analysis). **Note:** The analysis for discomforts was adjusted for age. *: $p < 0.05$

The occurrence of most pregnancy-related discomforts increased from the second to third trimester, while the occurrence of constipation and shoulder stiffness or headache decreased. The tendency for the occurrence of the two discomforts of current study was almost equivalent to previous reports. A previous study in the United States showed that the occurrence of constipation decreased (26.3% to 15.7%) from the second to the third trimester [16], and in another cross-sectional study, the occurrence of headache decreased (44.9% to 37.6%) and that of constipation increased (38.6 to 45.2%) from the second to the third trimester [3]. Here, we observed a difference when compared with the previous study of Nazik and Eryilmaz, where the prevalence of constipation decreased in our study but increased in that study. However, it is worth noting that ours is a longitudinal study, and thus, we collected information during each trimester from the same participants, and that found that some discomforts might improve during the course of pregnancy. Therefore, pregnant women should pay attention to constipation and shoulder stiffness or headache during the early stages of pregnancy, especially during the second trimester, and of other discomforts thereafter.

We found significant differences in the occurrence of analyzed discomforts according to pre-pregnancy BMI. The occurrence of hip joint or pubis pain was higher during the second trimester, and the occurrence of sleeping difficulty, hand or finger stiffness, leg cramps, low back pain, hip joint or pubis pain, and shoulder stiffness or headache during the third trimester was higher in the high BMI group than in the normal BMI group. These discomforts are related to changes in the musculoskeletal and cardiovascular systems, common during pregnancy [17-21]. Overweight exposes the musculoskeletal system to excessive loads, resulting in conditions such as low back pain and hand pain (22,23). Overweight might also affect the cardiovascular system [24,25], leading to leg cramps and hand or finger stiffness.

Accordingly, discomforts, especially those related to the musculoskeletal and cardiovascular systems, might occur in the high BMI group. The occurrence of shoulder stiffness or headache during the second trimester, and constipation during the third trimester, was higher in the low BMI group than in the normal BMI group. These discomforts are related to fluctuations in hormones such as estrogen, occurring during pregnancy [26,27], and low weight might determine hormone imbalance, in particular by decreasing the effects of female hormones [28]. Therefore, pre-pregnancy low BMI might hamper the hormonal balance and lead to the observed pregnancy-related discomforts.

In recent years, the occurrence of obesity has increased worldwide [29],while women, especially young adults, attempt to lose weight despite being of normal weight or underweight [30,31]. In this respect, our study showed that both women with high or low pre-pregnancy BMI have a high risk of pregnancy-related discomforts that not only affect their quality of life and limit their daily activities, but might also have a negative impact on their children's health [4,5]. Hence, our findings suggest that young women should maintain an appropriate BMI before getting pregnant, in order to have a good pregnancy progression.

This study has several limitations. First, we could not obtain information on some factors that could affect pregnancy-related discomforts (e.g. living environment, parity, and hormonal fluctuations during pregnancy). These factors may have affected our results. Second, we could not investigate the occurrence of additional discomforts that occur during pregnancy: it is known that more than 30 discomforts might be experienced by pregnant women [3]. In the future, a similar study investigating various pregnancy-related discomforts should be conducted, taking into account the different factors related to the discomforts.

Conclusion

The current study showed that pregnancy-related discomforts have different trends in occurrence from the second to the third trimester. Therefore, pregnant women should pay attention to different discomforts depending on the pregnancy period. Moreover, pre-pregnancy low or high BMI might be a risk factor for pregnancy-related discomforts, regardless of age. These findings indicate that women should maintain an appropriate BMI before pregnancy to prevent potential discomforts during pregnancy.

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A Preseason Checklist for Predicting Elbow Injury in Little League Baseball Players

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Background: Despite pitch count limits, the incidence of Little League elbow is increasing. A risk-evaluation tool capable of predicting which players are predisposed to throwing injury could potentially prevent injuries.

Purpose: To investigate the effectiveness of a risk factor checklist for predicting elbow injury in Little League baseball players during 1 season. The hypothesis was that a preseason risk-evaluation checklist could predict which players were predisposed to elbow injury.

Study Design: Case-control study; Level of evidence, 3.

Methods: A preseason risk-evaluation checklist was distributed to Little League baseball teams in Japan. Six months later, a follow-up questionnaire was mailed to determine injuries sustained during the season. Logistic regression analysis was performed, assigning presence or absence of elbow injury during the season as the dependent variable, and an injury risk score (IRS) was developed based on the statistically significant variables. Receiver operating characteristic (ROC) curve analysis was conducted to determine the predictive validity of the checklist and the optimal cutoff IRS.

Results: Data from 389 Little League players were analyzed. Among them, 53 players experienced an elbow injury requiring medical treatment during the season. Six checklist items associated with a medical history of throwing injury, pitch volume, and arm fatigue were found to be significant. Responses to the items could predict the players who were susceptible to injury during the season, with a two-thirds cutoff value for a 6-item checklist (area under the curve, 0.810; sensitivity, 0.717; specificity, 0.771).

Conclusion: Results from a 6-item preseason checklist can predict which Little League players are to sustain an elbow injury by the end of the season.

Clinical Relevance: The ability to predict which Little League baseball players are predisposed to elbow injury allows parents and coaches to initiate preventive measures in those players prior to and during the baseball season, which could lead to fewer elbow injuries.

Keywords: Little League elbow; prevention; checklist

Throwing injuries in young baseball players are a serious problem. Little League elbow, including epicondylitis and osteochondrosis dissecans, is one of the most severe throwing injuries, occurring in 20% to 40% of school-aged pitchers.[11,13-15] Such an injury can prematurely end a baseball career[4]; therefore, adults should do everything possible to protect children from these injuries.

Many studies have reported the risk factors for throwing injury. Ways to prevent such injuries, including limiting the number of pitches, have been suggested to protect players.[3,14,15,18] As a result, USA Baseball Medical and Safety Advisory Committee guidelines were developed in 2006 to provide recommendations for limiting pitch counts similar to recommendations made in Japan in 1995.[9,20,22] However, there are several problems with these recommendations. For one, these recommendations are meaningless without strict compliance, and a small proportion of coaches have complied with these recommendations. According to 2 recent studies, coaches in the United States answered 43% of questions regarding pitch count and rest periods correctly, whereas 28% of coaches complied with the recommendations in Japan.[1,22] Because few coaches follow these limits regularly, despite evidence that the number of pitches strongly influences development of Little League

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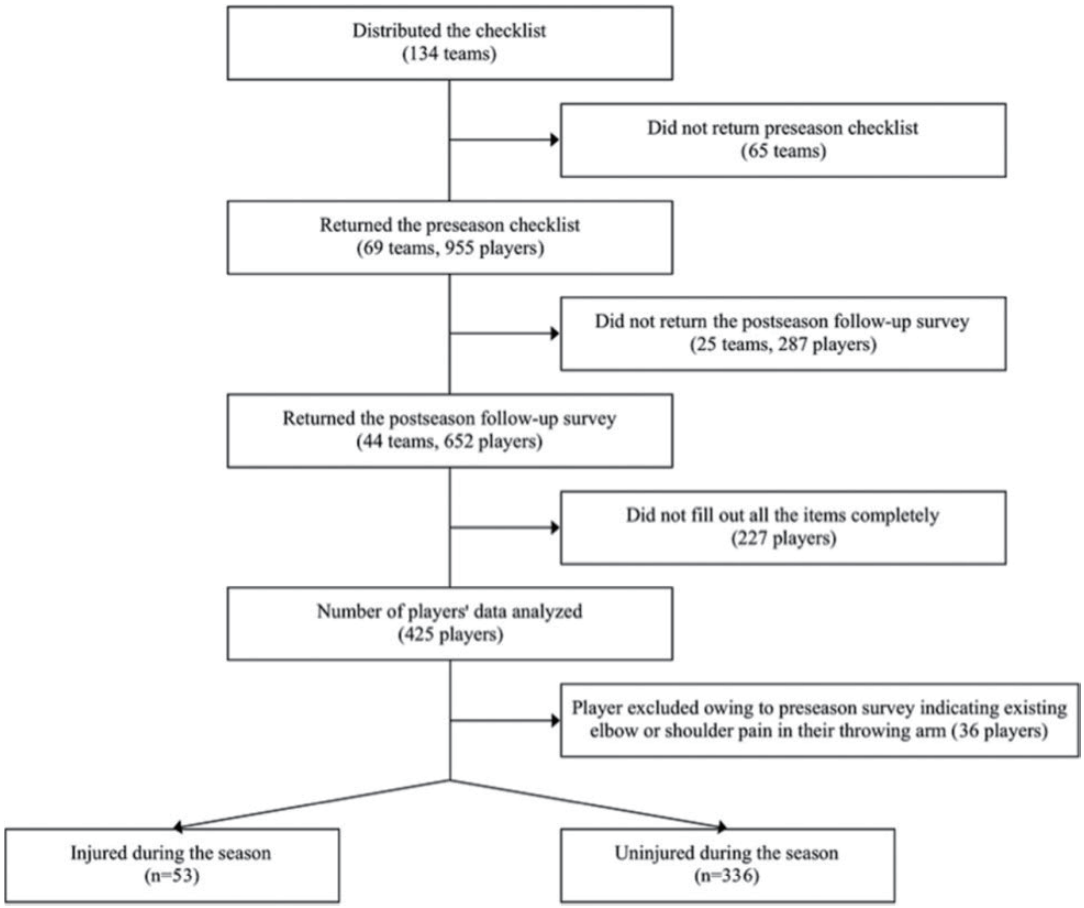

Figure 1. Flowchart showing the process of this research.

elbow, especially in Japan, another approach for prevention of elbow injury must be considered in addition to these limits.

When developing another strategy for primary prevention of youth baseball elbow injury, several things must be taken into account. First, it must be easy for coaches and parents to understand. Medical evaluation by experts, including medical doctors and physical therapists, has been reported to be an effective prevention strategy for throwing injury.[7] However, a large number of children play baseball worldwide: 5.7 million children in eighth grade or lower in the United States, and there are nearly 15,000 elementary school baseball teams in Japan.[2,8] With such large numbers, it is almost impossible for medical specialists to assess all of them. Therefore, coaches and parents, most of whom have no medical knowledge, inevitably have to be responsible for protecting children from injury. Second, the various factors must be evaluated comprehensively. Research has shown that the amount of force placed on a player's elbow is the principal risk factor for injury. Such force is influenced by pitching mechanics, pitch type, and pitch volume.[10] Other risk factors, including arm fatigue, playing baseball outside the league, and range of motion of the shoulder joint, also have been reported.[6,15,18] Thus, prevention cannot focus only on 1 factor, but various factors must be considered comprehensively to successfully prevent throwing injury.

Considering this, we created a checklist for predicting which Little League baseball players are predisposed to elbow injury. To our knowledge, studies using a checklist for injury prevention have not been performed for baseball or any other sport. The aim of the current study was to investigate the effectiveness of a risk factor checklist for predicting elbow injury in Little League baseball players during 1 season.

METHODS

This prospective cohort study investigated the effectiveness of a checklist for predicting elbow injury in young baseball players. Initially, we created an original checklist for predicting Little League elbow based on previous research that explored the risk factors for this injury. This checklist was distributed to each team's representative who participated in the annual tournament in Kyoto and Fukuoka in March 2013 (preseason). A total of 134 teams in 4 cities in Japan received the checklist (Figure 1). To increase response reliability, the players' parents were instructed to work with the players to help complete the

TABLE 1
Preseason Checklist for Little League Players

	Yes	No
Condition of the elbow of the pitching arm		
1. Is the angle of the elbow in full extension different between your arms?	1	0
2. Do you have pain in the elbow of the pitching arm when it is extended?	1	0
3. Is the angle of the elbow in full flexion different between your arms?	1	0
4. Do you have pain in the elbow of the pitching arm when it is flexed?	1	0
Information about baseball playing		
5. Are you a regular player?	1	0
6. Do you often throw more than 100 pitches per week?	1	0
7. Do you have an off-season (a period when you do not throw anything for at least 1 month)?	0	1
8. Does your pitching arm often feel fatigued while playing baseball?	1	0
9. Do you practice throwing breaking pitches often?	1	0
10. Are you more often satisfied than dissatisfied with your performance?	0	1
11. Do you often play catch or throw a ball in noncompetition settings?	1	0
12. Do you often participate in resistance training?	1	0
Pitching form		
13. Is your elbow in a straight line with your shoulders (horizontal shoulder abduction) when in the cocking stage of a pitch?	0	1
14. Is your elbow at or above shoulder level (abducted $\geq 90^{\circ}$) in the acceleration phase of a pitch?	0	1
15. Is your front foot pointed straight on an extension of the pitcher-catcher line or angled slightly toward third base (for a right-handed pitcher)?	0	1
16. Is your front foot angled straight toward or slightly inward from the catcher?	0	1
Flexibility		
17. When prone with knees flexed at 90°, is there a difference in the internal rotation angle of your hips?	1	0
18. Is there a difference in the height of your thumbs when the dorsum of your hand is placed at maximum height against your back on the line of the spine? (Reflecting range of motion of the shoulders when internally rotated.)	1	0
19. With your knee fully flexed, is the distance between your heel and buttock 0 cm for both legs? (Reflecting flexibility of the quadriceps.)	0	1
20. When you are fully flexed at the waist, is the distance between your fingers and the floor 0 cm? (Reflecting flexibility of the hamstrings.)	0	1

checklist. After the parents had verified the responses, the players/parents mailed back the completed checklist. The purpose and methods of this study were explained to the players' parents in detail in a verbal statement, and written informed consent was obtained from the coaches and parents. This study was approved by the Institutional Review Board of Kyoto University (Approval No. E1669).

Checklist

We designed a 20-item checklist (Table 1). These items were chosen according to 2 criteria: (1) whether the factors were already reported as risk factors for throwing-related elbow injury in previous studies and (2) whether the coaches and parents could easily evaluate the factors with reliability. This checklist consisted of 4 areas of risk: condition of the elbow of the throwing arm, information about the individual player's baseball playing and practice, pitching form, and flexibility. All questions had to be easily answered by parents without medical knowledge. Therefore, pitching form and flexibility were illustrated using photos, and alternative flexibility tests rather than direct range of motion or muscle flexibility tests were used because of the large size of the participants. In addition, each question was designed with a yes/no answer. Intrarater reliability of pitching form and flexibility evaluation was tested by 10 subjects who were not medical specialists, who assessed each variable twice on separate occasions. Pitching form was quoted from the pitching model developed by the American Sports Medicine Institute and American Baseball Foundation.[5,14] These intrarater tests revealed kappa coefficient consistency >0.60 (range, 0.73-1.00) for all 4 pitching form and flexibility variables. These data ranges suggested that coaches and parents with no medical knowledge could answer with substantial reliability.[12] In addition to the checklist questions, basic player information was investigated, including age, height, weight, number of months playing baseball, field position (fielder, pitcher, catcher, or pitcher who concomitantly plays catcher), number of team-training days per week (<4 or $\geq$4), number of self-training days per week ($\leq$6 or 7), presence or absence of pain with throwing in the shoulder or elbow in the preseason, pain in the shoulder or elbow of the throwing arm over the preceding 12 months, and elbow or shoulder injury that ever required medical treatment.

Follow-up Survey

Six months after distributing the preseason checklist, a follow-up questionnaire to determine injuries sustained during the season was distributed to players who had returned the preseason questionnaire. For this study, injury was defined as an elbow injury in the dominant arm sustained during the baseball season that required any medical treatment at least once. After the players' parents had verified the responses, the completed follow-up survey was returned.