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The Association of Gestational Weight Gain and the Effect on Pregnancy Outcome Defined by BMI Group among Women Delivered in Hospital Kuala Lumpur (HKL), Malaysia: A Retrospective Study

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ABSTRACT

This study attempts to determine the association of gestational weight gain and the effect on pregnancy outcome defined by their Body Mass Index (BMI) among pregnant women. Retrospective study involved 436 singleton pregnancy women who delivered in Hospital Kuala Lumpur (HKL) from 1st January to 31st December 2010. The subjects were stratified into four BMI group according to World Health Organization (WHO) (underweight <18.5 kg m^{-2}, normal: 18.5-24.9 kg m^{-2}, overweight: 25-30 kg m^{-2} and obese: 30 kg m^{-2}). Each of BMI group then, classified into 3 categories of Gestational Weight Gain (GWG) (lower increment, normal and high increment). This classifying of GWG group was done according to the US Institute of Medicine (IOM), 2009 guidelines. Pregnancy outcome been analyzed according to the GWG during pregnancy for each BMI group and calculated the crude OR from simple logistic regression modules. 15.1, 40.1, 28.7 and 16.1% of the subjects were underweight, normal BMI, overweight and obese, respectively. In normal BMI women, gestational age outcome and neonatal outcome were significantly associated with inadequate weight gain during pregnancy ($p = 0.046$ and $p = 0.002$). Among low GWG of normal BMI women, the crude OR for premature birth and low birth weight were 2.872 and 4.976 (95% CI = 1.009-8.170 and 1.316-18.815), respectively compared with normal GWG. This study shows that normal BMI with lower GWG may result in adverse outcome. In addition, inadequate weight gain during pregnancy can result in significant complication.

Key words: Gestational weight gain, pregnancy outcome, normal BMI, body mass index

INTRODUCTION

Gestational weight gain is a modifiable factor that can be controlled through nutritional counseling in order to gain adequate weight gain during pregnancy (Sajjad and Khan, 2010). Adequate gestational weight gain can be protective in order to against poor maternal nourishment during early pregnancy (Salihu *et al*., 2009; Khoushabi and Saraswathi, 2010). Gestational Weight Gain (GWG) is one of the risk factor of health consequences and it is very important factor to be controlled (Tsukamoto *et al*., 2007; McDonald *et al*., 2010; Cedergren, 2006).

Recommendations for weight gain during pregnancy were differed from a single target for all women to different targets, depending on maternal Body Mass Index (BMI). During pregnancy, pregnant women have been advised to gain certain weights that have been recommended as to have a safe pregnancy and healthy infants without any complication (Ochsenbein-Kolble *et al.*, 2007; Islam and Ullah, 2005; Borazjani *et al.*, 2011).

Women who gained less GWG were associated delivered small-gestational-age (SGA) for infants or low birth weight, while large-gestational-age (LGA) for infants or macrosomia infant associated with those having GWG outside the recommendation (Devader *et al.*, 2007). Excessive weight gain might contribute to an increased risk of preterm delivery, cesarean delivery and macrosomia, while inadequate weight gain during pregnancy will lead to preterm delivery and low birth weight (Rodrigues *et al.*, 2010; Nohr *et al.*, 2008; Briese *et al.*, 2009; Oken *et al.*, 2009; Kabali and Werler, 2007). Gaining high and low weight gain have greater risk of low birth weight and high birth weight (macrosomia) and might related to obesity in later life (Johansson *et al.*, 2007). Supported by Kiel *et al.* (2007), women that gained less weight had significantly lower risk of LGA birth but high significant in SGA birth. Abrams *et al.* (2000) explained that, caesarean delivery and maternal weight gains was significant when weight gain was exceeded 16 kg. Underweight and average height women with low weight gain was tend to expose to preterm delivery, while overweight and obese women that gained low GWG was having moderate risk of preterm delivery (Wang *et al.*, 2010; Schieve *et al.*, 2000; Mohsen and Wafay, 2007).

This study attempts to determine the association between GWG with pregnancy outcome that was categorized into three categories which were birth outcome, gestational age outcome and neonatal outcome defined by their BMI among pregnant women.

MATERIALS AND METHODS

Study design: This study was retrospective record review data approved by ethics committees and medical research, Ministry of Health, Malaysia and director of Hospital Kuala Lumpur was designed to identify the association between GWG and pregnancy outcome at Obstetrics and Gynecology (O and G) record data units of Hospital Kuala Lumpur.

Study subjects: Subjects were comprised of 436 live born and singleton pregnancy women from the Hospital Kuala Lumpur (HKL) on 1st January to 31st December 2010. Subjects involved in this study were selected through inclusion criteria and availability of certain information and also pre-pregnancy weight that had from phone call interview.

Maternal BMI and GWG: At enrollment, we obtained maternal data of height and a phone call interview of pre-pregnancy weight gain, as to calculate pre-pregnancy BMI and total weight gain, GWG. The data of BMI was divided according to the World's Health Organization's definitions of underweight as having BMI<18.5), normal weight (18.5 = BMI<25), overweight (25 = BMI<30), and obese having BMI≥30). We determined total gestational weight gain as the difference between phone call interview of pre-pregnancy weight and the data reported of last clinically measured weight recorded prior to delivery. Each of BMI group then, classified into 3 categories of GWG (lower increment, normal and high increment. This classifying of GWG group was done according to the US Institute of Medicine (IOM), 2009 Guidelines on Recommendations for Total and Rate

of Weight Gain during Pregnancy by Pre-pregnancy Body Mass Index (BMI) of the mother (Mobasheri and Golalipour, 2007).

Pregnancy outcomes: Birth outcome was described as mode of delivery of baby. In this study, birth outcome can be categorized as having normal or caesarean delivery. Woman that was delivered the baby through surgical incisions was categorized as caesarean delivery, while delivery of fetus through vaginal known as normal delivery. Gestational age outcome defined as age of fetus the moment the baby was delivered by the mother. Data of gestational age outcome gained from the record data then was classified into premature and normal birth. Premature birth can be described as baby born before 37 weeks of the gestation while normal birth baby born between 37 to 42 weeks of gestation. Neonatal outcomes identified as first weight of the newborn obtained after the birth. Neonatal outcome in this study can be classified as low birth weight, normal and high birth weight or macrosomia. Woman who having less than 2.5 kg weight of the baby was categorized as low birth weight. Normal weigh of baby was between 2.5 kg to 4 kg, while macrosomia or high birth weight baby have weight more than 4.0 kg (Veghari, 2009). The data of subjects then were categorized into these three categories.

Data analysis: The test that been used were descriptive test, Pearson's chi square and simple logistic regression. Descriptive statistics test include mean and Standard Deviation (SD) for continuous variable and frequency distribution for categorical variables (Ojofeitimi *et al*., 2008). Pearson's chi square test was performed to identify the association between GWG and pregnancy outcome for each BMI group. The risk association of GWG with pregnancy outcome was using simple logistic regression test. Binary logistic test was used to determine the crude OR. The data was processed using Statistical Package for Social Sciences (SPSS) version 16.0.

RESULTS

Table 1 showed a total of 436 women met the eligibility criteria. 15.1, 40.1, 28.7 and 16.1% of the subjects were underweight, normal BMI, overweight and obese, respectively. The age of underweight women reported in this study was younger than other BMI group (25.68±3.884, 28.03±4.015, 28.45±3.007 and 28.87±3.611, respectively). Malay was the higher ethnicity among the subjects (86.4, 82.9, 85.6 and 85.7%, respectively). The percentage of multigravida was the highest parity among the subjects (57.6, 65.7, 72 and 78.6%, respectively). In underweight group, the percentage of low increment GWG was higher than other BMI groups (62.1, 30.3, 17.6 and 16.1%, respectively). In caesarean delivery, overweight and obese was high than the other two groups (16.7, 32, 35.2 and 38.6%, respectively). While premature birth, underweight was the highest among other BMI group (25.8, 16, 16 and 7.1%, respectively). Low birth weight was the highest in underweight (16.7, 10.3, 7.2 and 1.4%, respectively) while macrosomia baby was high in overweight (4.8%) and obese (4.3%).

According to Table 2 showed the association of pregnancy outcome and GWG for each of BMI group. There was significantly association between GWG and gestational age outcome (Chi-square = 0.046, df = 2, p = 0.005). In addition, there was also a significantly association between GWG and neonatal outcome (Chi-square = 0.002, df = 2, p = 0.005). However, there was no significantly association between GWG and birth outcome (chi-square = 10.782), df = 2, p = 0.727) in normal BMI group. On the other hand, in underweight, overweight and obese there were no significant association between gestational weight gain and the incidence of pregnancy outcome.

Table 1: Data of demographic, GWG, pregnancy outcome and parity data of pregnant women in HKL

All (n = 436)

	Underweight		Normal		Overweight		Obese	
Parameters	n	%	n	%	n	%	n	%
No. of subjects (n)								
Age (years), Mean±SD	25.68 ± 3.884		28.033 ± 4.015		28.45 ± 3.007		28.87 ± 3.611	
Ethnicity								
Malay	57	86.4	145	82.9	107	85.6	60	85.7
Others	9	13.6	30	17.1	18	14.4	10	14.3
Parity								
Primigravida	28	42.4	60	34.3	35	28	15	21.4
Multigravida	38	57.6	115	65.7	90	72	55	78.6
GWG								
Lower increment	41	62.1	53	30.3	22	17.6	12	17.1
*Normal	13	19.7	54	30.9	33	26.4	21	30
High increment	12	18.2	68	38.9	70	56	37	52.9
Pregnancy outcome								
Birth outcome	55	83.3	119	68	81	64.8	43	61.4
Normal	11	16.7	56	32	44	35.2	27	38.6
Caesarean gestational age outcome								
Premature	17	25.8	28	16	20	16	5	7.1
Normal	49	74.2	147	84	105	84	65	92.9
Neonatal outcome								
Low birth weight	11	16.7	18	10.3	9	7.2	1	1.4
Normal	55	83.3	157	89.7	110	88	66	94.3
Macrosomia	-	-	-	-	6	4.8	3	4.3

*Normal GWG, Underweight: 12.7-18.1 kg, Normal: 11.3-15.9 kg, Overweight: 6.8-11.3 kg and Obese: 5-9 kg

The risk association of pregnancy outcome and Gestational Weight Gain (GWG) that was only significant in normal BMI group was listed in Table 3. In gestational age outcome, women that gained low GWG (less than 12.6 kg) have high risk of getting premature birth with crude OR 2.872 [1.009, 8.170] and it statistically significant ($p<0.05$). Besides that, in neonatal outcome, women who gained low GWG have high risk of low birth weight (crude OR 4.976 [1.316, 18.815] and it is statistically significant with $p<0.05$.

DISCUSSION

Result showed that, inadequate weight gain during pregnancy in normal BMI group can result in significant complication. In normal BMI, low GWG was significant associated in having premature birth and low birth weight. This study was supported by study done by Choi *et al.* (2011) on the effect of gestational weight gain towards perinatal outcome among Korean women found that normal BMI women who were having less weight gain have significantly incidence on having premature birth compared those gain within the recommendation. Moreover, study by Galtier *et al.* (2008) explained that low GWG and premature birth was notably associated. However, contra study by Chen *et al.* (2010) found that, premature birth was more significant occur in overweight and obese than normal BMI group. Durie *et al.* (2011) and Baeten *et al.* (2001) found that less than recommended weight gain were associated with small-gestational weight gain or low birth weight infant in normal BMI group.

Table 2: The association of pregnancy outcome and gestational weight gain (GWG) for each of BMI group

	n (%)				
Category	Low (n = 41)	Normal (n = 13)	High (n = 12)	χ^2 statistic	p-value
Underweight					
Gestational weight gain (GWG) and birth outcome				2.452 (2)	0.293
Normal (n = 55)	36 (87.8)	9 (69.2)	10 (83.3)		
Caesarean (n = 11)	5 (12.2)	4 (30.8)	2 (16.7)		
GWG and gestational age outcome				5.712 (2)	0.057
Premature (n = 17)	14 (34.1)	3 (23.1)	0 (0)		
Normal (n = 49)	27 (65.9)	10 (76.9)	12 (100)		
GWG and neonatal outcome				4.915 (2)	0.086
Low body weight (n = 11)	10 (24.4)	1 (7.7)	0 (0)		
Normal (n = 55)	31 (75.6)	12 (92.3)	12 (100)		
Macrosomia (n = 0)	-	-	-		
Normal					
GWG and birth outcome				0.29 (2)	0.909
Normal (n = 119)	37 (69.8	37 (68.5)	45 (66.2)		
Caesarean (n = 56)	16 (30.2)	17 (31.5)	23 (33.8)		
GWG and gestational age outcome				6.146 (2)	0.046*
Premature (n = 28)	14 (26.4)	6 (11.1)	8 (11.8)		
Normal (n = 147)	39 (73.6)	48 (88.9)	60 (88.2)		
GWG and neonatal outcome				12.62 (2)	0.002*
Low body weight (n = 18)	12 (22.6)	3 (5.6)	3 (4.4)		
Normal (n = 157)	41 (77.40	51 (94.4)	65 (95.6)		
Macrosomia (n = 0)	-	-	-		
Overweight					
GWG and birth outcome				0.476 (2)	0.788
Normal (n = 81)	14 (63.6)	23 (69.7)	44 (62.9)		
Caesarean (n = 44)	8 (36.4)	10 (30.3)	26 (37.1)		
GWG and gestational age outcome				4.622 (2)	0.099
Premature (n = 20)	6 (27.3)	7 (21.1)	7 (10)		
Normal (n = 105)	16 (72.7)	26 (78.8)	63 (90)		
GWG & neonatal outcome				7.304 (4)	0.121
Low body weight (n = 9)	2 (9.1)	5 (15.2)	2 (2.9)		
Normal (n = 110)	19 (86.4)	28 (84.8)	63 (90)		
Macrosomia (6)	1 (4.5)	0 (0)	5 (7.1)		
Obese					
GWG and birth outcome				2.934 (2)	0.232
Normal (n = 43)	6 (50)	16 (76.2)	21 (56.8)		
Caesarean (n = 27)	6 (50)	5 (23.8)	16 (43.2)		
GWG and gestational age outcome				1.989 (2)	0.370
Premature (n = 5)	2 (16.7)	1 (4.8)	2 (5.4)		
Normal (n = 65)	10 (83.3)	20 (95.2)	35 (94.6)		
GWG and neonatal outcome				5.710 (4)	0.222
Low body weight (n = 1)	1 (8.3)	0 (0)	0 (0)		
Normal (n = 66)	10 (83.3)	20 (100)	36 (97.2)		
Macrosomia (3)	1 (8.3)	0 (0)	1 (2.7)		

*Significant when $p<0.05$

Table 3: The risk association of pregnancy outcome and GWG in normal BMI group

Outcome	n	Crude OR	95% CI	Wald (df)	p-value
Gestational age					
Lower increment	53	2.872	1.009-8.170	3.911 (1)	0.048*
Normal	54	1.0		5.844 (2)	0.054
High increment	68	1.067	0.346-3.284	0.013 (1)	0.910
Neonatal					
Lower increment	53	4.976	1.316-18.815	4.3 (1)	0.038*
Normal	54	1.0		9.126 (2)	0.010
High increment	68	0.785	0.52-4.052	0.084 (1)	0.352

*Significant when $p<0.05$

In present study also showed that, the risk of having premature birth is high among normal BMI women that gained low gestational weight gain. Besides that, normal women that gained GWG less than the recommendation have high risk to get low birth weight infants. This study was supported by Abrams *et al.* (2000) stated that low increment in gestational weight gain (GWG) had significant higher risk of getting preterm delivery. In addition, Salihu *et al.* (2009) conducted a study in 1989 through 1997 among women of Missouri found that low BMI had strongly high risk for getting preterm birth baby. Nielsen *et al.* (2006) had achieved, it was significantly higher risk in small-gestational-age or low birth weight (SGA) infants among women that gained less than the recommendation. Supported by Abrams *et al.* (2000) reported that too little weight gain during pregnancy have high risk in having low birth weight infants. In addition, study done by Devader *et al.* (2007) performed a study on singleton women with normal pre-pregnancy BMI using Missouri birth certificate data for 1999-2001 discovered that, the risk of having small-gestational-age (SGA) infants or low birth weight was higher with decreasing Gestational Weight Gain (GWG). Moreover, the increased risk of SGA and decreased birth weight was associated with normal BMI (Merrill *et al.*, 2011).

There were some limitations to this study. The pre-pregnancy weight was obtained from self reported that get through phone call interview and we did not know whether the pregnant women were able to report their pre-pregnancy weight accurately. Besides that, even the total subjects were 436 subjects, when it stratified into four BMI group, the numbers of subject became smaller in each group of BMI. This is not enough to determine certain risk factors of pregnancy outcome and to determine the association between Gestational Weight Gain (GWG) and pregnancy outcome in other BMI group.

Despite such limitations, this study has several strengths. We comprehensively, analyzed the influence of Gestational Weight Gain (GWG) on pregnancy outcome in the same group of pregnant Malaysia women and confirmed that gestational weight gain has significant association on pregnancy outcome. In addition, present result suggested that, low Gestational Weight Gain (GWG) have high risk in normal BMI group that caused premature birth and low birth weight. As the overweight and obese population has rapidly increased nowadays all over the world, even in women in childbearing age, normal BMI pregnant women have been relatively neglected.

CONCLUSION

In conclusion, this study shows that normal BMI with lower Gestational Weight Gain (GWG) may result in adverse outcome. In addition, inadequate weight gain during pregnancy can result in significant complication. The result of this study, are expected to be highly helpful during

consultations with women of childbearing age and pregnant women with respect to weight control and healthy balance food intake.

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REFERENCES

Abrams, B., S.L. Altman and K.E. Pickett, 2000. Pregnancy weight gain: Still controversial. Am. J. Clin. Nutr., 71: 1233S-1241S.

Baeten, J.M., E.A. Bukusi and M. Lambe, 2001. Pregnancy complications and outcomes among overweight and obese nulliparous women. Am. J. Public Health, 91: 436-440.

Borazjani, F., K.A. Ahmadi and P. Shahri, 2011. Relationship between maternal nutritional-social status and pregnancy outcomes. Pak. J. Nutr., 10: 724-727.

Briese, V., M. Voigt, J. Wisser, U. Borchardt and S. Straube, 2009. Risks of pregnancy and birth in obese primiparous women: An analysis of German perinatal statistics. Arch. Gynecol. Obstet., 283: 249-253.

Cedergren, M., 2006. Effects of gestational weight gain and body mass index on obstetric outcome in Sweden. Int. J. Gynecol. Obstet., 93: 269-274.

Chen, Z., J. Du, L. Shao, L. Zheng, M. Wu, M. Ai and Y. Zhang, 2010. Prepregnancy body mass index, gestational weight gain and pregnancy outcomes in China. Int. J. Gynecol. Obstet., 109: 41-44.

Choi, S.K., I.Y. Park and J.C. Shin, 2011. The effects of pre-pregnancy body mass index and gestational weight gain on perinatal outcomes in Korean women: A retrospective cohort study. Reprod. Biol. Endocrinol., 10.1186/1477-7827-9-6.

Devader, S.R., H.L. Neeley, T.D. Myles and T.L. Leet, 2007. Evaluation of gestational weight gain guidelines for women with normal prepregnancy body mass index. Obstetr. Gynecol., 110: 745-751.

Durie, D.E., L.L. Thornburg and J.C. Glantz, 2011. Effect of second-trimester and third-trimester rate of gestational weight gain on maternal and neonatal outcomes. Obstet. Gynecol., 118: 569-575.

Galtier, F., I. Raingeard, E. Renard, P. Boulot and J. Bringer, 2008. Optimizing the outcome of pregnancy in obese women: From pregestational to long-term management. Diab. Metabol., 34: 19-25.

Islam, M.N. and M.O. Ullah, 2005. Knowledge and attitude of urban pregnant women of Bangladesh toward nutrition, health care practice and delivery place. J. Medical Sci., 5: 116-119.

Johansson, K., Y. Linne, S. Rossner and M. Neovius, 2007. Maternal predictors of birthweight: The importance of weight gain during pregnancy. Obstet. Res. Clin. Prac., 1: 243-252.

Kabali, C. and M.M. Werler, 2007. Pre-pregnant body mass index, weight gain and the risk of delivering large babies among non-diabetic mothers. Int. J. Gynecol. Obstetrics, 97: 100-104.

Khoushabi, F. and G. Saraswathi, 2010. Association between maternal nutrition status and birth weight of neonates in selected hospitals in Mysore city, India. Pak. J. Nutr., 9: 1124-1130.

Kiel, D.W., E.A. Dodson, R. Artal, T.K. Boehmer and L.L. Terry, 2007. Gestational weight gain and pregnancy outcomes in obese women how much is enough? Obstet. Gynecol., 110: 752-758.

McDonald, S.D., Z. Han, S. Mulla and J. Beyene, 2010. Overweight and obesity in mothers and risk of pretem birth and low birth weight infants: Systematic review and metaanalyses. Br. Med. J., 1: 1-20.

Merrill, M.L., C.R. Stein, P. Landrigan, S.M. Engel and D.A. Savitz, 2011. Prepregnancy body mass index, smoking during pregnancy and infant birth weight. Ann. Epidemiol., 21: 413-420.

Mobasheri, E. and M.J. Golalipour, 2007. The effect of pre-pregnancy body mass index on gestational weight gain and pregnancy outcome in Gorgan, North Iran. J. Med. Sci., 7: 905-908.

Mohsen, M.A. and H.A. Wafay, 2007. Influence of maternal anthropometric measurements and serum biochemical nutritional indicators on fetal growth. J. Medical Sci., 7: 1330-1334.

Nielsen, J.N., K.O. O`Brien, F.R. Witter, S.C. Chang, J. Mancini, M.S. Nathanson and L.E. Caulfield, 2006. High gestational weight gain does not improve birth weight in a cohort of African American adolescents. Am. J. Clin. Nutr., 84: 183-189.

Nohr, E.A., M. Vaeth, J.L. Baker, T.I.A. Sorensen, J. Olsen and M.K. Rasmussen, 2008. Combined associations of prepregnancy body mass index and gestational weight gain with the outcome of pregnancy. Am. J. Clin. Nut., 87: 1750-1759.

Ochsenbein-Kolble, N., M. Roos, T. Gasser and R. Zimmermann, 2007. Cross-sectional study of weight gain and increase in BMI throughout pregnancy. Europ. J. Obstet. Gynecol. Reprod. Biol., 130: 180-186.

Ojofeitimi, E.O., P.O. Ogunjuyigbe, R.A. Sanusi, E.O. Orji, A. Akinlo, S.A. Liasu and O.O. Owolabi, 2008. Poor dietary intake of energy and retinol among pregnant women: implications for pregnancy outcome in southwest Nigeria. Pak. J. Nutr., 7: 480-484.

Oken, E., K.P. Kleinman, M.B. Belfort, J.K. Hammitt and M.W. Gillman, 2009. Associations of gestational weight gain with short and longer-term maternal and child health outcomes. Am. J. Epidemiol., 170: 173-180.

Rodrigues, P.L., L.C. de Oliveira, A.D.S. Brito and G. Kac, 2010. Determinant factors of insufficient and excessive gestational weight gain and maternal-child adverse outcomes. Nut., 26: 617-623.

Sajjad, R. and A. Khan, 2010. Nutrient intakes of pregnant women in comparison to the reference intake. Pak. J. Nutr., 11: 166-171.

Salihu, H.M., A.K. Mbah, A.P. Alio, H.B. Clayton and O. Lynch, 2009. Low pre-pregnancy body mass index and risk of medically indicated versus spontaneous preterm singleton birth. Europ. J. Obstet. Gynecol. Reprod. Biol., 144: 119-123.

Schieve, L.A., M.E. Cogswell, K.S. Scanlon, G. Perry and C. Ferre *et al*., 2000. Prepregnancy body mass index and pregnancy weight gain: Associations with preterm delivery. Am. College Obstet. Gynecol., 96: 194 -200.

Tsukamoto, H., H. Fukuoka, K. Inoue, M. Koyasu, Y. Nagai and H. Takimoto, 2007. Restricting weight gain during pregnancy in Japan: A controversial factor in reducing perinatal complications. Europ. J. Obstet. Gynecol. Reprod. Biol., 133: 53-59.

Veghari, G., 2009. Iron supplementation during pregnancy and birth weight in Iran: A retrospective study. Pak. J. Biol. Sci., 12: 427-432.

Wang, T., J. Zhang, X. Lu, W. Xi and Z. Li, 2010. Maternal early pregnancy body mass index and risk of preterm birth. Early Hum. Dev., 1: 1-7.