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不同喂养方式对婴儿骨密度及维生素 A 的影响

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摘要 目的：探讨不同喂养方式对婴儿骨密度、维生素 A 的影响。**方法：**选择 2015~2016 年来我院体检的婴儿 120 例，根据不同喂养方式的不同分为母乳喂养组、混合喂养组及人工喂养组，比较三组婴儿 1、3、6 月的身长、头围、体质量、骨密度，6 月时的维生素 A 及 6 月内的患病率。**结果：**三组婴儿 1、3、6 月内身长、体质量及头围对比差异无统计学意义(P>0.05)；1 月、3 月时，母乳喂养组与混合喂养组骨密度与明显高于人工喂养组(P<0.05)；母乳喂养组与人工喂养组对比差异无统计学意义(P>0.05)；6 月时，混合喂养组婴儿的骨密度显著高于人工喂养组和母乳喂养组(P<0.05)，人工喂养组显著低于母乳喂养组(P<0.05)。6 月时，母乳喂养组的维生素 A 明显低于人工喂养组及混合喂养组(P<0.05)。母乳喂养组 6 月内的患病率明显低于混合喂养组及人工喂养组(P<0.05)。**结论：**6 个月前不同喂养方式对婴儿的体格发育无明显影响，而 6 个月左右母乳喂养的婴儿骨密度及维生素 A 含量均低于混合喂养，母乳喂养可降低婴儿的患病率，6 个月内应提倡母乳喂养。

关键词：母乳喂养；人工喂养；混合喂养；骨密度；维生素 A；发病率

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Effects of Different Feeding Methods on the Bone Mineral Density and Vitamin A of Infants

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ABSTRACT Objective: To explore the effects of different feeding patterns on the bone mineral density and vitamin A of infants. **Methods:** 120 cases of infants underwent physical examination in our hospital from 2015 to 2016 were selected. According to different feeding methods, they were divided into the breastfeeding group, mixed feeding group and artificial feeding group. The body length, head circumference, body mass, bone mineral density were observed at 1, 3, and 6 months, vitamin A and the prevalence rate in 6 months were compared among three groups. **Results:** There was no significant difference in the body length, body weight and head circumference among the three groups of infants at 1, 3 and 6 months (P>0.05); The bone mineral density of breastfeeding group and mixed feeding groupat 1, 3 months were significantly higher than that of the artificial feeding group (P<0.05). There was no significant difference between breastfeeding group and artificial feeding group (P>0.05). At 6 months, the bone mineral density of mixed feeding group and breastfeeding group were significantly higher than that of artificial feeding group, while the mixed feeding group was significantly higher than that of the breastfeeding group(P<0.05). At 6 months, the vitamin A of breastfeeding group was significantly lower than those of the artificial feeding group and mixed feeding group (P<0.05). The prevalence o breastfeeding group was obviously lower than those of the artificial feeding group and mixed feeding group(P<0.05). **Conclusions:** In the 6 months after birth, different feeding methods had no significant effecton the physical development of infants, and 6 months or so breastfeeding baby bone mineral density and vitamin A were lower than the mixed feeding group, breastfeeding can reduce the prevalence of infants, breastfeeding should be advocate in the 6 months after birth.

Key words: Breast feeding; Artificial feeding; Mixed feeding; Bone mineral density; Vitamin A; incidence

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前言

婴儿的骨量水平自出生之日起随着时间的增长一直呈升高状态，青春期时达到峰值，儿童、青少年时期是活的骨量峰值的一个关键时段，从 35 岁逐渐出现骨丢失，故儿童和青少年时期若能获得足够的骨量堆积，那么在一定程度上可以预防成年后出现的骨质疏松[1,2]。遗传因素及环境因素是影响儿童及少年峰值骨量的因素，多数学者认为骨质疏松环境因素占 20 %，主

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要是通过户外运动、生活环境、膳食、家庭情况等影响的[3,4]。目前，国内关于骨密度以及影响骨密度的相关因素的报道和研究较多，但对于不同喂养方式对骨密度的影响的相关研究较少，何种喂养方式更能促进骨密度增长尚不确定[5,6]。

维生素 A 是一种人体必需的维生素，可以促进儿童的生长发育，同时可抑制肿瘤、保持细胞完整性，还可以影响儿童的视觉系统[7-9]。有研究表明维生素 A 可促进机体免疫反应，刺激呼吸道粘膜上 B 淋巴细胞，产生免疫抗体；且对呼吸道感染的婴幼儿，在治疗过程中补充维生素 A，可抑制临床症状的持续发生，减少发作频率，对婴幼儿的生长、发育、免疫应答有重要作用[10,11]。目前，喂养方式对婴幼儿体内维生素 A 的研究较少[12]。因此，本研究主要探讨了不同喂养方式对婴儿维生素 A 及骨密度的影响。

1 资料与方法

1.1 一般资料

选择 2015~2016 年来我院体检的婴儿 120 例，其中男婴 65 例，女婴 55 例。根据喂养方式的不同，分为 3 组，母乳喂养组 38 例，人工喂养组 37 例，混合喂养组 45 例。纳入标准：出生孕周为 37~42 周，出生体重为 3.0~4.0 kg，父母身体健康、良好，6 个月内未添加固体食物者，6 个月内纯母乳或人工喂养者。排除标准：有并发外伤、骨折者，服用影响骨代谢的药物者，患有内分泌及代谢性疾病、代谢性疾病家族史患者；母亲在孕期有各种疾病者；出生后患有各种疾病者。本研究经医院伦理委员会批准同意，所有婴儿家属知情同意。三组婴儿的身长、体质量对比差异无统计学意义(P>0.05)，具有可比性。

表 1 三组婴儿的一般资料对比

Table 1 Comparison of the general information among three groups of infants

Groups	n	Male/female	Body length(cm)	Body weight(kg)	Head circumference(cm)
Breastfeeding group	38	20/18	52.4± 2.8	3.6± 0.2	34.6± 3.1
Artificial feeding group	37	19/18	53.5± 3.1	3.5± 0.3	33.9± 2.8
Mixed feeding group	45	22/23	51.9± 2.7	3.7± 0.5	35.2± 2.9

1.2 方法

母乳喂养组为只给婴儿母乳喂养，除水及必须的钙剂、鱼肝油外不添加其他饮料或食品；人工喂养：出生后未吃过母乳，完全采用婴儿配方奶粉喂养；混合喂养：6 个月内母乳及婴儿配方奶粉混合喂养，同时可添加必须的钙剂、鱼肝油等药品。

1.3 观察指标

(1)1、3、6 个月时由专人用同一仪器测量婴儿的体质量、身长及头围，体质量用婴儿电子秤，精确读数至 0.1 kg；身长用卧位身长测量仪，精确至 1 cm；头围测量用软皮尺，精确至 0.1 cm；(2)1、3、6 个月时用美国澳诺生物医学的 BMV-1000 型超声骨质分析仪在婴儿安静、无哭闹时暴露左小腿，在左侧胫骨中 1/3 段内侧面由同一操作者进行检测；(3)6 个月时抽取婴儿 3 mL 静脉血，用美国 Agilent 公司的超高效液相色谱测量维生素 A；(4)通过来院体检时询问婴儿家长，记录三组婴儿的患病率。

1.4 统计学方法

使用 SPSS 软件分析处理数据，计量资料用 $\bar{x}\pm s$ 表示，组间比较使用 t 检验或方差分析；计数资料用%表示，组间比较用卡方检验，以 P<0.05 为差异具有统计学意义。

2 结果

2.1 三组婴儿不同时期的体质量对比

出生后 1、3、6 月，三组婴儿的体质量对比差异无统计学意义(P>0.05)。

表 2 三组婴儿不同时期的体质量对比($\bar{x}\pm s$, kg)

Table 2 Comparison of the body weight among three groups of infants at different times($\bar{x}\pm s$, kg)

Groups	n	1 month	3 months	6 months
Breastfeeding group	38	5.02± 0.52	7.43± 0.71	8.17± 0.85
Artificial feeding group	37	4.92± 0.61	7.29± 0.68	8.34± 1.02
Mixed feeding group	45	5.13± 0.58	7.36± 0.80	8.19± 1.13

2.2 三组婴儿不同时期的身长对比

出生后 1、3、6 月，三组婴儿的身长对比差异无统计学意义(P>0.05)。

表 3 三组婴儿不同时期的身长对比($\bar{x}\pm s$, cm)

Table 3 Comparison of the body length among three groups of infants at different times($\bar{x}\pm s$, cm)

Groups	n	1 month	3 months	6 months
Breastfeeding group	38	56.41± 2.13	64.13± 3.15	68.41± 2.98
Artificial feeding group	37	56.19± 2.09	64.58± 3.13	68.50± 3.12
Mixed feeding group	45	56.22± 2.41	65.39± 3.39	68.29± 3.42

2.3 三组婴儿不同时期的头围对比

出生后1、3、6月，三组婴儿的头围对比差异无统计学意义(P>0.05)。

表4 三组婴儿不同时期的头围对比($\bar{x}\pm$ s, cm)

Table 4 Comparison of the head circumference among three groups of infants at different times($\bar{x}\pm$ s, cm)

Groups	n	1 month	3 months	6 months
Breastfeeding group	38	38.41± 1.85	40.32± 1.52	43.15± 2.59
Artificial feeding group	37	37.25± 2.07	39.41± 1.06	42.21± 2.42
Mixed feeding group	45	38.42± 1.43	40.14± 1.61	43.69± 3.01

2.4 三组婴儿不同时期的骨密度对比

出生后1、3月时，母乳喂养组与混合喂养组骨密度与明显高于人工喂养组(P<0.05)；母乳喂养组与人工喂养组对比差异无统计学意义(P>0.05)；出生后6月时，混合喂养组婴儿的骨密度显著高于人工喂养组和母乳喂养组(P<0.05)，人工喂养组显著低于母乳喂养组(P<0.05)。

表5 三组婴儿不同时期骨密度的对比($\bar{x}\pm$ s, g/cm^2)

Table 5 Comparison of the bone mineral density among three groups of infants at different times($\bar{x}\pm$ s, g/cm^2)

Groups	n	1 month	3 months	6 months
Breastfeeding group	38	2831.4± 25.6	2899.5± 26.1	2886.6± 22.4
Artificial feeding group	37	2751.4± 26.1	2783.6± 29.3	2818.7± 20.6
Mixed feeding group	45	2800.1± 21.9	2841.6± 28.4	2946.5± 21.6

2.5 三组婴儿不同时期的维生素A对比

出生后6月时，母乳喂养组的维生素A为0.16± 0.03 mg/L，人工喂养组的含量为0.19± 0.02 mg/L，混合喂养组的含量为0.19± 0.02 mg/L，母乳喂养组的维生素A明显低于人工喂养组及混合喂养组(P<0.05)。

2.6 三组婴儿的患病率对比

母乳喂养组婴儿6个月内共出现1例腹泻，2例感冒，1例肺炎，总患病率10.5%(4/38)；人工喂养组出现感冒6例，肺炎2例，腹泻3例，总患病率29.7 %(11/37)；混合喂养组感冒3例，肺炎2例，腹泻4例，总患病率20.0 %(9/45)，母乳喂养组的发病率最低，组间对比差异明显(P<0.05)。

3 讨论

母乳喂养对婴幼儿疾病的预防、体格、智力、运动及心理发育等方面有一定促进作用，世界卫生组织推荐所有婴儿出生后6个月内应接受纯母乳喂养，但是各种因素慧导致母乳喂养难以保证，从而出现了混合喂养及人工喂养的喂养方式[13,14]。体质量、身长、头围能反映婴幼儿生长发育状况，喂养方式对婴幼儿的生长发育具有重要影响[15,16]。因此，本研究探讨了不同喂养方式对婴儿体格的影响。本研究结果显示6个月内，不同喂养方式对婴儿体质量、头围、身长的影响不明显。有研究表明人工喂养的婴儿身长、体重的增长量高于母乳喂养，但此差别从6个月后逐渐出现[17]，与本研究结果相符。

骨骼对人体主要起到支撑作用，如果儿童体内维生素D不足，则会导致钙、磷代谢紊乱，严重的甚至会造成慢性营养性疾病，诱发肺炎、贫血、腹泻等症状[18]。生命早期的骨密度值是预测成年后骨骼状况的一个最佳指标，定期检查婴儿的钙营养情况，及早发现钙营养低下，及时补充钙营养对婴儿正常生长有重要作用[19]。目前，关于不同喂养方式对婴儿骨密度影响的研究较少，何种喂养方式对婴儿的骨量水平更好有深远意义[20]。因此，本研究探讨了喂养方式对婴儿骨密度的影响。本研究结果显示母乳喂养组1月、3月婴儿的骨密度显著高于人工喂养组，但与混合喂养组差异不显著；母乳喂养组6月时的骨密度显著高于人工喂养组，显著低于混合喂养组，主要是由于婴儿骨密度受母乳中钙含量的影响，产后1个月时，母乳中钙含量最高，产后1~4个月内母乳中钙含量逐渐升高或稳定不变，之后呈下降趋势。因此，6个月时母乳中钙含量降低，母乳营养成分已不能完全满足婴儿的营养需要，导致婴儿的骨密度低于混合喂养组[21,22]，我们认为婴儿在6个月左右应及时添加配方奶粉。母乳营养全面且均衡，是婴儿的最佳食物，而人工喂养时多用牛、羊等兽乳替代母乳，除了物种的差异，牛、羊奶中的矿物质比例、蛋白质含量、脂肪形态等影响婴儿肠道的消化、吸收[23]，导致人工喂养组婴儿在1、3、6月时的骨密度含量明显低于其他两组。

有研究表明，不同喂养方式对新生儿影响不大，0~4个月新生儿总血清维生素A含量普遍较低，且母乳喂养的婴儿缺失更为严重[24-26]，与本研究结果相似，可能是由于母乳中维生素A含量普遍偏低，不能维持新生儿需求导致的，需要混合喂养。此外，母乳喂养组婴儿1、3、6月内的疾病发生率明显低于其他两组，而混合喂养组的疾病发生率明显低于人工喂养组，主要是由于母乳中含有婴儿所需的全部营养成分，且母乳乳清蛋白中有抗感染的免疫蛋白，可以保护婴儿免遭感染[27]；而配方奶中不含母乳中所含有的免疫蛋白，因此人工喂养的组的婴儿抗病能力较差，易患腹泻、呼吸道感染等疾病，表明母乳喂养可增强婴儿对疾病的抵抗能力[28-30]。

综上所述，6个月前不同喂养方式对婴儿的体格发育无明显影响，而6个月左右母乳喂养的婴儿骨密度及维生素A含量均低于混合喂养组，可能与母乳中钙含量及维生素A含量较低有关，但母乳喂养可提高婴儿的免疫力，在出生6个月内应提倡母乳喂养，6个月后应适当添加营养物质，满足婴儿的

生长发育要求。

参 考 文 献(References)

[1] Jemielita T O, Leonard M B, Baker J, et al. Association of 25-hydroxyvitamin D with areal and volumetric measures of bone mineral density and parathyroid hormone: impact of vitamin D-binding protein and its assays[J]. Osteoporosis International, 2016, 27(2): 617-626

[2] Tastan Y, Kann P H, Tinneberg H R, et al. Low bone mineral density and vitamin d deficiency correlated with genetics and other bone markers in female Turkish immigrants in Germany [J]. Clini cal Rheumatology, 2016, 35(11): 1-7

[3] Darlow B A, Graham P J. Vitamin A supplementation to prevent mortality and short- and long-term morbidity in very low birth weight infants [J]. Cochrane Database of Systematic Reviews, 2011, 7 (4): CD000501

[4] Canfield L M, Kaminsky R G. Red palm oil in the maternal diet improves the vitamin A status of lactating mothers and their infants[J]. Food & Nutrition Bulletin, 2017, 21(2): 144-148

[5] Mihatsch W A, Braegger C, Bronsky J, et al. Prevention of vitamin K deficiency bleeding in newborn infants: aposition paper by the ESPGHAN committee on nutrition [J]. Journal of Pediatric Gastroenterology & Nutrition, 2016, 63(1): 123-129

[6] Murray J S, White J. Vitamin A supplementation in infants and children[J]. Journal for Specialists in Pediatric Nursing Jspn, 2016, 21(4): 212-217

[7] Schwartz E, Zelig R, Parker A, et al. Vitamin A supplementation for the prevention of bronchopulmonarydysplasia in preterm infants: an update [J]. Nutrition in Clinical Practice Official Publication of the American Society for Parenteral & Enteral Nutrition, 2017, 32 (3): 346-353

[8] Schmiedchen B, Longardt A C, Loui A, et al. Effect of vitamin A supplementation on the urinary retinol excretion in very low birth weight infants[J].European Journal of Pediatrics, 2016, 175(3): 365-372

[9] Sam N, Seth O A, Poku A K, et al. Vitamin A status and body pool size of infants before and after consuming fortified home-based complementary foods[J]. Archives of Public Health, 2016, 74(1): 10

[10] Gallo S, Hazell T, Vanstone C A, et al. Vitamin D supplementation in breastfed infants from Montréal, Canada: 25-hydroxyvitamin D and bone health effects from a follow-up study at 3 years of age[J]. Osteoporos Int, 2016, 27(8): 2459-2466

[11] Lopezteros V, Limonmiro A, Astiazarangarcia H, et al. 'Dose-to-Mother' deuterium oxide dilution technique:an accurate strategy to measure vitamin A Intake in breastfed Infants [J]. Nutrients, 2017, 9 (2):169

[12] 陶恩福, 袁天明. 维生素 A 与早产儿疾病 [J]. 中国当代儿科杂志, 2016, 18(2): 177-182
Tao En-fu, Yuan Tian-ming. Vitamin A level and diseases of premature infants [J]. Chinese journal of contemporary pediatrics, 2016, 18 (2): 177-182

[13] Huynh J, Lu T, Liew D, et al. Vitamin D in newborns. A randomised controlled trial comparing daily and single oral bolus vitamin D in infants[J]. Journal of Paediatrics & Child Health, 2017, 53(2): 163-169

[14] Oyunga M A, Grant F K E, Omondi D O, et al. Prevalence and predictors of vitamin A deficiency among infants in Western Kenya using a cross-sectional analysis [J]. African Journal of Food Agriculture Nutrition & Development, 2016, 16(1): 10765-10785

[15] Strand T A, Ulak M, Chandyo R K, et al. The effect of vitamin B 12, supplementation in Nepalese infants on growth and development: study protocol for a randomized controlled trial [J]. Trials, 2017, 18 (1): 187

[16] Srinivasan N, Chandramathi J, Prabhu A S, et al. Vitamin D deficiency and morbidity among preterm infants in a developing country [J]. International Journal of Contemporary Pediatrics, 2017, 4(2): 499[A1]

[17] Holick M F, Hosseinnezhad A, Tabatabaei F. Multiple fractures in infants who have Ehlers-Danlos/hypermobility syndrome and or vitamin D deficiency: A case series of 72 infants whose parents were accused of child abuse and neglect[J]. Dermato-Endocrinology, 2017, 9 (1): e1279768

[18] Emmerson A J B, Dockery K, Mughal M Z, et al. Vitamin D status of White pregnant women and infants at birth and 4 months in North West England: a cohort study [J]. Maternal & Child Nutrition, 2017: e12453

[19] Djekic-Ivankovic M, Weiler H, Jones G, et al. Vitamin D status in mothers with pre-eclampsia and their infants: a case-control study from Serbia, a country without a vitamin D fortification policy [J]. Public Health Nutrition, 2016, 20(10): 1825-1835

[20] Cetinkaya M, Erener-Ercan T, Kalayci-Oral T, et al. Maternal/neonatal vitamin D deficiency: a new risk factor for necrotizing enterocolitis in preterm infants[J]. Journal of Perinatology Official Journal of the California Perinatal Association, 2017, 37(6): 32-36

[21] Wickramasinghe V P, Lanerolle P, Arambepola C, et al. Association of iron and vitamin A status with birth weight and anaemia among 6 month old infants in an urban population of Sri Lanka [J]. Journal of the National Science Foundation of Sri Lanka, 2017, 45(2): 113

[22] Mittal M, Sharma B. Vitamin A supplementation for prevention of bronchopulmonary dysplasia in very low birth weight infants [J]. International Journal of Contemporary Pediatrics, 2016,31 (5): 1355-1357[A2]

[23] Wicklow B, Gallo S, Majnemer A, et al. Impact of vitamin D supplementation on gross motor development ofhealthy term infants: a randomized dose-response trial [J]. Physical & Occupational Therapy in Pediatrics, 2016, 41(3): 1-13

[24] Vaziri F, Dabbaghmanesh M H, Samsami A, et al. Vitamin D supplementation during pregnancy on infant anthropometric measurements and bone mass of mother-infant pairs: a randomized placebo clinical trial[J]. Early Human Development, 2016, 103(2): 61-68

[25] Kassab M, Shaban I, Mohammad K, et al. Prevalence of hypovitaminosis D among jordanian healthy infants:a descriptive cross sectional study[J]. Journal of Pediatric Nursing, 2016, 31(2): e119-e125

[26] Christensen N, Sondergaard J, Fisker N, et al. Infant respiratory tract infections or wheeze and maternalvitamin D in pregnancy: a systematic review [J]. Pediatric Infectious Disease Journal, 2017, 36 (4): 384-391

[27] Chebaya P, Karakochuk C D, March K M, et al. Correlations between maternal, breast milk, and infantvitamin B12 concentrations among mother-infant dyads in vancouver, Canada and Prey Veng, Cambodia: anexploratory analysis[J]. Nutrients, 2017, 9(3): 270

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营养状况可能影响部分氨基酸浓度[20]。

综上所述,串联质谱技术筛查可早期发现新生儿遗传代谢病,灵敏度理想,但其受新生儿胎龄、出生体重、采血时间的影响,假阳性率高。采用串联质谱技术筛查新生儿遗传代谢病的可靠性很大程度上依赖于截断值的选择,因而在结果判断时应参考其胎龄、出生体重、采血时间等因素选择截断值以降低假阳性率。

参 考 文 献(References)

[1] Villoria JG, Pajares S, López RM, et al. Neonatal Screening for Inherited Metabolic Diseases in 2016 [J]. Semin Pediatr Neurol, 2016, 23(4): 257-272

[2] Verma IC, Puri RD. Global burden of genetic disease and the role of genetic screening[J]. Semin Fetal Neonatal Med, 2015, 20(5): 354-363

[3] Park KJ, Park S, Lee E, et al. A Population-Based Genomic Study of Inherited Metabolic Diseases Detected Through Newborn Screeningy [J]. Ann Lab Med, 2016, 36(6): 561-572

[4] Yoon HR. Screening newborns for metabolic disorders based on targeted metabolomics using tandem mass spectrometry[J]. Ann Pediatr Endocrinol Metab, 2015, 20(3): 119-124

[5] Tomatsu S, Kubaski F, Sawamoto K, et al. Newborn screening and diagnosis of mucopolysaccharidoses: application of tandem mass spectrometry[J]. Nihon Masu Sukuriningu Gakkai Shi, 2014, 24(2): 19-37

[6] Kiykim E, Zeybek CA, Zubarioglu T, et al. Inherited metabolic disorders in Turkish patients with autism spectrum disorders [J]. Autism Res, 2016, 9(2): 217-223

[7] 张延玮,谢洁娜,郭书邑,等.广东省汕头市新生儿遗传代谢疾病筛查结果分析[J].临床输血与检验, 2016, 18(6): 571-573
Zhang Yan-wei, Xie Jie-na, Guo Shu-yi, et al. Anaylsis of Newborn Metabolic Disease Screening in Shantou City of Guangdong Province from 2012 to 2015[J]. Journal of Clinical Transfusion and Laboratory Medicine, 2016, 18(6): 571-573

[8] 费阳,王薇,赵海建,等.我国新生儿遗传代谢病筛查质量指标[J].中华检验医学杂志, 2016, 39(7): 556-558
Fei Yang, Wang Wei, Zhao Hai-jian, et al. Quality indicators for inherited metabolic diseases screening tests in China[J]. Chinese Journal of Laboratory Medicine, 2016, 39(7): 556-558

[9] Han L, Han F, Ye J, et al. Spectrum analysis of common inherited metabolic diseases in Chinese patients screened and diagnosed by tandem mass spectrometry[J]. J Clin Lab Anal, 2015, 29(2): 162-168

[10] 李景仪,吴元明,杨颖,等.一例酪氨酸血症患儿的临床特征及相关致病基因分析[J].现代生物医学进展, 2016, 16(5): 816-819
Li Jing-yi, Wu Yuan-ming, Yang Ying, et al. The Clinical Manifestation and Related Pathogenic Gene Analysis of One Newborn with Tyrosinemia[J]. Progress in Modern Biomedicine, 2016, 16(5): 816-819

[11] Moat SJ, Rees D, King L, et al. Newborn blood spot screening for sickle cell disease by using tandem mass spectrometry: implementation of a protocol to identify only the disease states of sickle cell disease[J]. Clin Chem, 2014, 60(2): 373-380

[12] Ankarberg-Lindgren C, Norjavaara E. Sensitive RIA measures testosterone concentrations in prepubertal and pubertal children comparable to tandem mass spectrometry [J]. Scand J Clin Lab Invest, 2015, 75 (4): 341-344

[13] Scott CR, Elliott S, Buroker N, et al. Identification of newborn infants at risk for a lysosomal disease by tandem mass spectrometry[J]. J Pediatr, 2013, 163(2): 498-503

[14] Hassan FA, El-Mougy F, Sharaf SA, et al. Inborn errors of metabolism detectable by tandem mass spectrometry in Egypt: The first newborn screening pilot study [J]. J Med Screen, 2016, 23(3): 124-129

[15] Kubaski F, Mason RW, Nakatomi A, et al. Newborn screening for mucopolysaccharidoses: a pilot study of measurement of glycosaminoglycans by tandem mass spectrometry [J]. J Inherit Metab Dis, 2017, 40(1): 151-158

[16] 侯有矶,邓勇莹,黄洁颜,等.串联质谱用于顺德区新生儿代谢遗传病筛查工作的临床价值 [J]. 检验医学与临床, 2016, 13(21): 3111-3113, 3116
Hou You-ji, Deng Yong-ying, Huang Jie-yan, et al. The clinical value of tandem mass spectrometry in the screening of neonatal metabolic genetic diseases in Shunde [J]. Laboratory medicine and clinic, 2016, 13(21): 3111-3113, 3116

[17] Poinsot P, Collardeau Frachon S, Restier L, et al. Childhood/adult-onset lysosomal acid lipase deficiency: A serious metabolic and vascular phenotype beyond liver disease-four new pediatric cases [J]. J Clin Lipidol, 2017, 11(1): 167-177

[18] 闫磊,杨尧,王艳,等.足月和早产新生儿的 LC-MS/MS 氨基酸谱和酰基肉碱谱分析[J].中国儿童保健杂志, 2016, 24(8): 791-794
Yan Lei, Yang Yao, Wang Yan, et al. The amino acid and acylcarnitine profile of full-term and premature newborns by LC-MS/MS[J]. Chinese Journal of Child Health Care, 2016, 24(8): 791-794

[19] Traglia M, Croen LA, Lyall K, et al. Independent Maternal and Fetal Genetic Effects on Midgestational Circulating Levels of Environmental Pollutants[J]. G3 (Bethesda), 2017, 7(4): 1287-1299

[20] Ye Q, Yin W, Zhang L, et al. The value of grip test, lysophosphatidylcholines, glycerophosphocholine, ornithine, glucuronic aciddecrement in assessment of nutritional and metabolic characteristics in hepatitis B cirrhosis[J]. PLoS One, 2017, 12(4): e0175165

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[28] Srinivasan K, Thomas T, Kapanee A R, et al. Effects of maternal vitamin B12 supplementation on early infant neurocognitive outcomes: a randomized controlled clinical trial [J]. Maternal & Child Nutrition, 2017, 13(2): e12325

[29] Wheeler B J, Taylor B J, Herbison P, et al. High-dose monthly maternal cholecalciferol supplementation during breastfeeding affects maternal and infant vitamin D Status at 5 months postpartum: a randomized controlledtrial[J]. Journal of Nutrition, 2016, 146(10): 1999-2006

[30] Helve O, Viljakainen H, Holmlundsuila E, et al. Towards evidence-based vitamin D supplementation in infants: vitamin D intervention in infants (VIDI) - study design and methods of a randomised controlled double-blinded intervention study[J]. Bmc Pediatrics, 2017, 17(1): 91