**Supplemental Digital Content:** Risks and Benefits of Swaddling Healthy Infants: An Integrative Review (Nelson A. M., 2017)

*Detailed Summary of Research in Swaddling Integrated Review*

| Author / Year  | Study Design | Country of Origin |  Study Aim |  Sample | Major Swaddling Findings  |
| --- | --- | --- | --- | --- | --- |
| **Development / Psychological Impact** |
| Manaseki-Holland et al. (2010) | RCT | Mongolia | Compare differences in mental and psychomotor development between swaddled / non-swaddled infants  | 1279 healthy Mongolian newborns | No significant differences were found in development at 11 to 17 mo. of age between traditionally swaddled and non-swaddled groups |
| Bystrova et al. (2009)\*  | RCT  | Russia | Evaluate long term impact of maternity home practices on mother-infant interaction  | 176 Russian maternal-newborn dyads, healthy infant | Swaddling decreased maternal responsiveness to her infant, positive affective involvement and mutuality/ reciprocity in the dyad |
| van Sleuwen et al. (2006) Blom et al. (2009)  | RCT | Netherlands | Compare the effectiveness of two interventions for excessive crying | 389 healthy Nederland infants  | Swaddling was equally effective as advice to introduce regularity, stimulus reduction and uniformity into infant care |
| Dennis & Dennis (1940) | Multiple Case Study Analysis | United States  | Investigate the effects of restraint on infant development | 105 Hopi Indian children (63 swaddled on cradle board, 42 not swaddled) | No differences between swaddled and non-swaddled groups related to the time when infants began to walk |
| **Pain Management** |
| Hashemi et al. (2016) | RCT | Iran | Compare effect of swaddling and breastfeeding on vaccine pain  | 131 healthy Iranian term newborns | 15 seconds after vaccination breastfeeding was slightly more effective than swaddling or the combination of both in decreasing mean pain intensity  |
| Leng et al. (2016) | RCT | China | Compare the effect of oral sucrose and nonnutritive sucking and/or swaddling on heel stick pain  | 670 Chinese newborns between 37 and 42 weeks | Nonnutritive sucking and swaddling when combined with oral glucose both decreased pain from deep heel sticks |
| Fallah et al. (2016) | RCT | Iran | Compare effect of kangaroo mother care, breastfeeding, and swaddling on vaccine injection pain  | 120 Iranian, healthy term infants on the 1st day of life | Swaddling found to be less effective than breastfeeding or kangaroo mother care in decreasing vaccine pain in healthy term infants |
| Morrow et al. (2010) | RCT  | United States | To measure differences in pain scores during heel lance procedures using swaddling versus standard position  | 42 American neonates | Pain scores for infants swaddled/held upright were significantly lower than those in the standard care position  |
| Wisdorf-Houtkooper (1997) | RCT | United States | Compare efficacy of pain management techniques for infants during innoculations | 42 American infants 3-5 months old | No significant difference found in behavioral state, crying duration or facial expression during or after immunization between pacifier, rocking, swaddling, or control groups |
| Campos (1989)  | Quasi-experimental | United States | Compare the effect of pacifiers and swaddling on decreasing pain from painful procedures | 32 American full term 2 week old infants32 American full term 2 month old infants | At 2 weeks heart rate and crying decreased more in the pacifier group than in the swaddling group, although at 2 months both were equally effective in decreasing pain  |
| **Sudden Infant Death Syndrome** |
| Pease et al. (2016) | Meta-analysis of 4 case-control or cohort design | AustraliaEnglandUnited States | Analyze study datarelated to SIDS and swaddling | In total 760 SIDS cases compared with 1759 control subjects | SIDS risk was greatly increased with prone sleeping and side sleeping with a small but significant associated with supine sleepingSwaddling risk increased with age |
| Oden et al. (2012) | Descriptive | United States | Assess knowledge, attitudes and practice related to swaddling among infant caregivers | 103 American caregivers of swaddled infants 0 to 3 months old | Parents use swaddling to comfort and most find it effectiveParents who routinely swaddle are more likely to place infants supine to sleep |
| Gerard et al. (2002)  | Quasi-Experimental  | United States | Investigate the impact of healthy swaddling on respiratory outcomes and acceptance of supine sleeping position in older infants | 30 healthy, American term infants7 healthy 33 to 36 week gestation at birthMean age 103 days | Most older infants accepted swaddling supine, although acceptance decreased with ageIncreased swaddle pressure associated with slightly increased respiratory rate and slightly lower heart rate |
| **Sudden Infant Death Syndrome****Infant Arousability, Sleep, Vital Signs** |
| Meyer & Erler (2011) | Quasi-Experimental  | German | Compare sleep profiles in swaddling and sleeping bag conditions | 80 healthy German infants  | Swaddling was found to significantly reduce the rate of spontaneous awakening, promote quiet sleep, and decrease awake time and sleep efficiency |
| Richardson et al. (2009, 2010) | RCT | Australia | Evaluate the effects of swaddling on infant arousability | 15 swaddled, 12 unswaddled, healthy Australian term infants | Decreased cortical arousals, sleep times and heart rate variability were found only in swaddled infants naïve to swaddling  |
| Narangerel et al. (2007) | RCT | Mongolia | To compare respiratory rates and oxygen saturations between swaddled and non-swaddled infants | 1275 healthy Mongolian infants, 9-10 weeks old | Swaddling had little or no clinical effect on respiratory rates or oxygen saturation  |
| Franco et al. (2005) | Quasi-experimental  | Belgium | Evaluate whether or not swaddling influences arousal thresholds | 16 healthy Belgium infants  | When infants were swaddled infants’ sleep efficiency increased and infants awaked less often. Also when swaddled less intense auditory stimuli were needed to induce cortical arousals during rapid eye movement sleep  |
| Franco et al. (2004)  | Quasi-experimental | Belgium | Evaluate the effects of swaddling on cardiac reactivity to auditory stimuli during sleep both supine and prone | 30 healthy Belgium infants (age range 8 to 15 weeks)  | Swaddling decreased infant heart rates only in the supine position, and greater heart increases followed auditory stimuli when supine infants were swaddled than when they were unswaddled |
| **Sudden Infant Death Syndrome****Thermoregulation**  |
| Bystrova et al. (2003)\* | RCT | Russia | Evaluate impact of delivery-ward routines on temperature in newborns | 176 Russian maternal-newborn dyads, healthy infant | Skin temperatures rose significantly in all groups from 30 to 120 minutes after birth minutes but foot temperature decreased in the infants swaddled or clothed in the nursery versus held skin-to-skin and only gradually increased over two days  |
| Grover et al. (1994) | Randomized prospective | United States | Determine whether bundling (swaddling) elevates the temperature of young infants  | 64 healthy, full term American infants (28 control, 36 bundled)  | Bundling caused a significant increase in skin temperature but not rectal temperature among healthy infants |
| Ponosby et al. (1993) | Secondary analysis of a case-control and prospective cohort study | Australian | Examine potential interactions of the prone position and multiple factors (including swaddling) on SIDS risk  | Australian Case control (58 SIDS infants, 120 control)Prospective cohort(22 SIDS infants, 213 control) | A significant interaction effect was found between prone position and type of mattress, swaddling and use of heat in roomProne positioning and swaddling increased SIDS risk 12-fold |
| Cheng & Partridge (1993) | Quasi-experimental | United States | Explore impact of extreme bundling and environmental temperature on infant temperature | 20 healthy, American term infants | Bundling in 5 blankets and hat or warm environments increased infant temperatures into the febrile range |
| Gilbert et al. (1992)  | Retrospective Case Control | England | Investigate role of infection and heavy wrapping in sudden infant death | Reports of 95 unexpected deaths of British infants 1week – 2 years | Wrapping with >10 tog value was associated with increased risk of death in infants >70 days old |
| Fleming et al. (1990) | Case Control | England  | Determine relationship between sleeping position, bedding and SIDS risk  | 72 British infants who died unexpectedly and 144 control infants | Overheating and prone positioning were independently associated with an increased risk of SIDS, especially in infants >70 days old |
| **Breastfeeding** |
| Dumas et al. (2013) | 2nd Analysis of Bystrova (2007a; 2007b)  | Russia | Evaluate impact of Russian maternity home practices on lactation performance | 176 Russian maternal-newborn dyads, healthy infant | Swaddling correlated with decreased infant wakefulness during breastfeeding at 4 days and rougher maternal affective response |
| White et al. (2012)  | Mixed Methods | Taiwan | Record data and views on breastfeeding and swaddling in a low resource environment | 982 Taiwanese maternal-newborn dyads17 primipara and 33 multipa in focus group  | Very high breastfeeding initiation rates and long breastfeeding duration documented in this culture where infants are swaddled soon after birth and breastfeeding strongly supported  |
| Bystrova et al.(2007a; 2007b) | RCT | Russia | Evaluate impact of Russian maternity home practices on lactation performance | 176 Russian maternal-newborn dyads, healthy infant | No differences in breastfeeding outcomes between skin-to-skin and swaddled groupsin the first 12 months |
| Moore et al. (2007)  | RCT | Russia | Compare impact of early skin-to-skin vs. swaddling on breastfeeding | 23 Russianmaternal-newborn dyadsInfants >37 weeks gestation | Skin-to-skin infants had higher mean sucking competency, fed sooner than those swaddledNo difference at 1 mo. |
|  Jansson et al. (1995) | Descriptive  | Pakistan | Evaluate effect of caring routines in a developing country  | 48 Pakistani vaginally delivered infants  | Separation from mother, early bathing, and swaddling found to decrease infant feeding cues |
| **Developmental Dysplasia of the Hip**  |
| Harcke et al. (2016) | Prospective Quasi-experimental pilot study | United States | Investigate how various swaddling techniques influence hip position/ dynamics | 30 American infants being treated for DDH  | Among tightly swaddled infants, limited flexion/ abduction documented and 1 unstable hip dislocated No change or limitation in hip stability in safe swaddling group  |
| Guner et al. (2013) | Prospective Descriptive | Turkey | Investigate the effects of swaddling and consanguineous marriage on DDH and associated risks | 265 4 week old Turkish infants | 61.9% of infants were swaddled and the risk of DDH was highly significant for swaddling  |
| Dogruel et al. (2008)  | Prospective Descriptive | Turkey | Investigate the capacity to detect DDH through clinical examination and risk factors | 3,541 Turkish infants(4-6 weeks of age)  | Frequency of 4.71% DDHSwaddling was strongest risk factor for DDH |
| Akman et al. (2007)  | Prospective Descriptive | Turkey | Evaluate hip ultrasonography and relation to etiologic factors | 497 Turkishinfants | Overall six fold increase in DDH found only among female swaddled infants  |
| Kremli et al. (2003)  | Prospective Descriptive | Saudi Arabia | Enlarge the knowledge of DDH in Saudi Arabia and known risk factors and compare with international figures | 600 Saudi pediatric patients with DDH | 71% of patients with DDH were swaddled for an average of 14.3 weeks |
| Chaarani et al. (2002) | Prospective, Quasi-experimental  | Qatar | Describe the impact of a public awareness campaign related to the dangers of swaddling on DDH | 260 “high risk” infants living in Qatari  (6 to 8 weeks old) | The number of babies with hip dysplasia was reduced 14% after the awareness campaign |
| Kutlu et al. (1992)  | Descriptive | Turkey | Determine the incidence and risk factors associated with DDH in central Turkey  | 4173 Turkish infants screened (3-24 months of age)  | Incidence of CDH 1.34%Significant relationship found between CDC and swaddling for a mean 45.3 days |
| Abd El-Kader Shaheen (1989) | Descriptive | Saudi Arabia | Describe the prevalence of wrapping (swaddling) and association with DDH | 414 Saudi children (50 with CDH) | Prevalence of swaddling was 84% in population sample and 82% among infants with CHD |
| Ishida (1977) | Quasi-experimental | Japan | Describe the impact of a professional educational program to discourage infant ‘wrapping” on the incidence of DDH | 5221 Japanese newborns  | A steady decrease over four years in the incidence of abnormalities of the hip was noted after the first year |
| **Respiratory Infection, Vitamin D deficiency, Rickets** |
| Urnaa et al. (2006) | Case Control | Japan | Explore the influence of swaddling on rickets onset and bone properties in children | 73 Japanese children age 7-10 with rickets and 70 children without rickets, all swaddled for 3-4 months as infants | The duration of swaddling did not influence the onset of rickets or bone properties in school aged children  |
| Wayse et al. (2004) | Case Control | India | Explore whether subclinical vitamin D deficiency is a risk factor for ALRI | 150 Indian children age 2-6 months (80 cases, 70 control)  | Subclinical vitamin D deficiency and nonexclusive breastfeeding were found to be significant risk factors for ALRIInfants swaddled when exposed to sunlight had higher risk |
| Yurdakok et al. (1990) | Descriptive | Turkey | Explore the extremely high incidence of pneumonia among traditionally swaddled infants | 186 Turkish infants (94 unswaddled, 29 partially swaddled, 63 completely swaddled) | Infants swaddled for > 3 months were 4 times more likely to develop pneumonia and URTI then unswaddled |

\* Signifies multiple publications reporting data from the same study

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