ADHERENCE AMONG PARENTS ON UNDER-FIVE CHILDHOOD IMMUNIZATION SCHEDULE: A REVIEW

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ABSTRACT

Background: Adherence on under-five childhood immunization schedule has been an area of study that has seldom been explored. Adherence has been the subject of focus in determine if the results of outbreaks and vaccine preventable disease is related to the adherence of the parents to the vaccine schedule.

Materials and Methods: A systematic review of articles on the factors of adherence on under-five childhood immunization schedule was performed using various keywords utilizing multiple databases (Medline, PubMed, Science Direct and CINAHL). Studies conducted between 2000 to present, English language and were either observational or qualitative designs were included.

Result: Of 45 articles identified, 13 studies were eligible for inclusion. The studies showed that the majority of factors were divided into modifiable and non-modifiable factors. These factors were then further classified into various groups according to its relevance. The modifiable factors were identified as knowledge, vaccine, awareness and perception towards childhood immunization. Whereas non-modifiable factors were sociodemographic factors of parent and child, logistic factors and administration factors.

Conclusion: There were many factors identified significantly to be associated with adherence among parents on under-five childhood immunization schedule.

Keywords: Factors of adherence, childhood immunization schedule, vaccine schedule.
1.0 Introduction

Adherence has been of the key major factor for the alarmingly high number of vaccine preventable diseases occurring even with data stating a very good coverage of vaccine. Adherence has multiple definitions according to various literatures with some defining it as defaulters, delay in the immunization schedule or incomplete immunization coverage. Even in developed countries such as the United States a worryingly high number of vaccine preventable diseases and outbreaks such as measles has been on the rise with 23 outbreaks reported and the biggest single outbreak involved 383 persons for 2014 alone with factors being attributed to misinformation, anti-vaccine groups and non-compliance to the immunization schedule (Nyhan et al., 2015). The study done by Hill et al (1991) in the United States of America demonstrated how the Hepatitis B vaccination was recorded as having good coverage but still had a high prevalence rate of transmission among the respondents. This was due to the adherence issues of not completing the immunizations on schedule with an average mean delay of 1.3 months. It found the significance of being not being adherent to jeopardizing the effectiveness of a Hepatitis B immunization program in that population. Vassiliki et al (2014) demonstrated in his prospective study that adherence to the immunization schedule was a key factor in the reduction of immunization coverage in Greece where there was more than 35% drop of immunization coverage from 2011 to 2014 among the under-five population. In Malaysia particularly several factors has been reported to play a role in the rise of vaccine preventable disease with similar trends as those reported by other countries and one of those issues has been identified as adherence to the under-five immunization schedule (Awadh et al., 2014). Adherence thus plays an important role in the effectiveness of an immunization. Measuring only the coverage may be misleading as the outbreaks that occur could be caused due to poor adherence to the immunization schedule rather than due to the ineffectiveness of the vaccine itself. In determining key factors for the reasons of poor adherence to the immunization schedule it will help enable health agencies to reduce and also improve adherence to the immunization schedule. Adherence however is attainable when the immunization schedule is followed to its date as closely as possible. Several factors have been identified that effect adherence to the immunization schedule such as the study by Awadh et al (2014) that identified knowledge as a factor, Yarwood et al (2005) identified attitude and practice in several studies such as Falagas & Zarkadoulia (2008) and Hill et al (1991). In this paper, scientific literatures were reviewed in order to determine the significant factors of adherence among parents on under-five childhood immunization schedule.

2.0 Materials and Methods

2.1 Research Strategy and Selection Criteria

A systematic review on searches of electronic databases and of bibliographies of studies and previous reviews was done. A broad search of databases was conducted initially using generic terms to identify the relevant search terms. The Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines was followed to conduct the review (Moher et. al., 2009). The following databases were searched PubMed, Medline, CINAHL and Science Direct for this systematic review. The titles of the study were initially screened and the abstract was analysed to determine its relevance. The full text of
articles was then obtained and the articles that fulfilled the inclusion criteria were then selected. The population was restricted to parents or guardians with children in the immunization schedule range and also to determine the factors that are associated with adherence. Studies being included in the review were cross-sectional studies, cohort studies, case-control studies and qualitative studies as the main goal was to determine the factors of adherence. The databases were searched to include studies from the year 2000 to the current date and included published articles in citation indexed journals and peer reviewed journals. The following medical subject heading (MeSH) search terms were used for the first level were “Adherence in childhood immunization schedule” AND “Factors associated with adherence”. Following the primary search the second level was applied with keywords to be more specific to the searches and included “Compliance” OR “Defaulters” OR “Influence” OR "Dropouts" AND “Determinants” OR “Predictors”.

2.2 Screening and Data Abstraction

Article citations were organized, downloaded and reviewed. The title, author, journal and year of publication were then screened for their title and abstract review. Articles were screened by two reviewers to determine if they included relevant information. Both reviewers had to agree that the article had the relevant information to be included in the study. If in any disagreement regarding the article arose, the most experienced researcher made the final decision regarding inclusion of the study. Adherence in this systematic review was determined to be those that received vaccination coverage in the stipulated time frame that was acceptable. The main researcher extracted the data. Duplicated publications were determined and excluded by comparing author names, study names and sample sizes. Information was extracted for the review from the articles obtained to cover the author name, year of publication and the country of study. The review than noted the study design, the sample size and the results. The results selected to be included in the study had to possess calculated crude odds ratio, adjusted odds ratio and relative risk ratios with 95% CI that does not include 1 or a p value less than 0.05 to have a significant factor included.

2.3 Quality Assessment

The quality assurance applied in this systematic review was by utilizing STROBE for the strength and quality of each individual study prior to selection. The individual studies that were evaluated under STROBE had to fulfil a minimum of 70% of the criterion on the checklist to be eligible to be included in the systematic review. Those with less than 70% were discarded to maintain a consistent level of study strength and quality.

2.4 Data Synthesis

The results were synthesised and placed in a logic framework but no meta-analysis was conducted. The logic framework shows the various results obtained and classified accordingly to its factors. The risk of bias across studies was limited, as the publication was not selected based on the origin of the studies or its journal impact factor.
**Table 1:** Summary of systematic review on factors of adherence among parents on under-five childhood immunization schedule (Publications year 2000 – Present).

<table>
<thead>
<tr>
<th>Author/Years/Location</th>
<th>Method</th>
<th>Type of Study</th>
<th>Sample Size</th>
<th>Results</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awadh et al., 2014 (Malaysia)</td>
<td>Pre and post-intervention survey questionnaire</td>
<td>Cross-sectional</td>
<td>n=73</td>
<td>Knowledge about childhood immunization increased significantly after the intervention compared to the baseline results (p &lt; 0.001). There were significant differences between knowledge and their educational level and monthly income (p &lt; 0.001 and p = 0.005), respectively.</td>
<td>1. Knowledge</td>
</tr>
<tr>
<td>Azhar et al., 2012 (Malaysia)</td>
<td>Standardized questionnaire from government clinics</td>
<td>Cross-sectional</td>
<td>n=315</td>
<td>Mother’s employment status showed a significant difference between the two groups in which 27.0% of employed mothers defaulted compared with 13.7% of unemployed mothers defaulted. (χ² = 7.193; p=0.007). There were significant associations between defaulters of immunization with mother’s employment status (OR=16.6, 95% CI: 5.6 – 49.3), family size (OR=4.1, 95%CI: 1.2 - 14.6) and mother’s age (OR=7.4, 95%CI: 1.1 – 48.2).</td>
<td>1. Mother’s employment. 2. Family size (number of siblings) 3. Mother’s age.</td>
</tr>
<tr>
<td>Barbacariu 2014 (Romania)</td>
<td>Direct interview and focus group discussion</td>
<td>Qualitative</td>
<td>n=350</td>
<td>Ages 30 – 35 had 58% were not adherent to the immunization schedule. Those who went to university represented 83% were not adherent. 53% who had a single child had low adherence to the immunization schedule. Most parents were worried of overloading an immature immune system. Most also claimed that being infected would create a natural immunity for their children.</td>
<td>1. Age 2. Low Education. 3. Number of children. 4. Vaccine effects. 5. Perceived benefits.</td>
</tr>
<tr>
<td>Babirye et al., 2012 (Uganda)</td>
<td>Child health data cards</td>
<td>Cross-sectional</td>
<td>n=821</td>
<td>Vaccinations that were not received within the recommended age ranges were associated with increasing number of children per woman (aRR =1.84, 95% CI 1.29 - 2.64), non-delivery at health facilities (aRR 1.58, 95% CI 1.02 - 2.46), being</td>
<td>1. Number of children per woman. 2. Non-delivery at health facilities.</td>
</tr>
</tbody>
</table>
unmarried (aRR 1.49, 95% CI 1.15 - 1.94) or being in the lowest wealth quintile (aRR 1.38, 95% CI 1.11 - 1.72).

3. Unmarried.
4. Lowest wealth quintile.

Bugvi et al., 2014 (Pakistan) Secondary analysis from national health data Cross-sectional n=2435 The likelihood of incomplete immunization was significantly associated with the father's occupation as a manual worker (AOR = 1.47, 95% CI 1.10 - 1.97), lack of access to information (AOR = 1.35, 95% CI 1.09 - 1.66), non-use of antenatal care (AOR = 1.33, 95% CI 1.07 - 1.66), children born in Baluchistan region (AOR = 1.74, 95% CI 1.12 - 2.70) and delivery at home (AOR = 1.39, 95% CI 1.14 - 1.69).

1. Fathers occupation.
2. Lack of access to information.
5. Home delivery.

Danis et al., 2010 (Greece) Self-administered questionnaire Cross-sectional n=4390 Those parents who perceived that the natural immunity is better than immunization did not follow the childhood immunization schedule (aRR = 1.26, 95% CI 1.03 – 1.54).

1. Perception of natural immunity.

Emmanuel et al., 2015 (Kenya) Structured questionnaire Case-control n=183 Independent determinants of infant vaccination completion were the child's age < 18 months (AOR = 4.2 95% CI 1.8 - 9.6), maternal age < 25 years (AOR = 2.5 95% CI 1.1 - 5.0), maternal tetanus toxoid vaccination status < 2 TT doses (AOR = 2.5 95% CI 1.2 - 5.4) and late receipt of BCG (AOR = 3.2 95% CI 1.4 - 7.3).

1. Child age less than 18 months.
2. Maternal age less than 25 years old.
3. Maternal toxoid vaccination status.
4. Late receipt of BCG.

Etana & Deressa 2012 (Ethiopia) Secondary data Cross-sectional n=536 Factors significantly associated with complete immunization were antenatal care follow-up (AOR = 2.4, 95% CI 1.2 - 4.9), being born in the health facility (AOR = 2.1, 95% CI 1.3 - 3.4), mothers' knowledge about the age at which vaccination begins (AOR = 2.9, 95% CI 1.9 - 4.6) and knowledge about the age at which vaccination completes (AOR = 4.3, 95% CI 2.3 - 8).

1. Antenatal care follow-up.
2. Born in health facility.
3. Knowledge on age of vaccination.
4. Knowledge on age of vaccine completion.
<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Sample Size</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feemster et al., 2009</td>
<td>Pro-forma</td>
<td>Retrospective Cohort n=54,429</td>
<td>Predictors of late or non-compliance to the immunization schedule were those with less than high school level of education (AOR = 1.23, 95% CI 1.08 – 1.38), age of mother less than 17 (AOR = 1.79, 95% CI 1.46 – 2.20), no prenatal visits (AOR = 2.31, 95% CI 1.95 – 2.73), smoker (AOR = 1.25, 95% CI 1.15 – 1.36), more than 3 children (AOR = 2.08, 95% CI 1.90 – 2.28) and follow up at public health centre (AOR = 2.02, 95% CI 1.42 – 2.88). 1. Low education. 2. Age of mother less than 17. 3. No prenatal visits. 4. Smoker. 5. More than 3 children. 6. Follow up at public health centre.</td>
</tr>
<tr>
<td>Gidado et al., 2014</td>
<td>Structured questionnaire</td>
<td>Cross-sectional n=450</td>
<td>Possessing satisfactory knowledge (AOR=18.4, 95% CI 3.6 - 94.7) and at least secondary education (AOR = 3.6, 95% CI 1.2 - 10.6) were significantly correlated with full immunization. 1. Satisfactory knowledge. 2. Secondary education.</td>
</tr>
<tr>
<td>Hong &amp; Chhea 2010</td>
<td>CDHS (Health survey data)</td>
<td>Cross-sectional n=4030</td>
<td>Those with dropouts (defined as those who received 1 DTP shot but failed to receive the rest) were identified as those in the lowest income (OR = 2.92, 95% CI 1.51 – 5.61). 1. Lowest income.</td>
</tr>
<tr>
<td>Jani et al., 2008</td>
<td>Guided questionnaire</td>
<td>Cross-sectional n=668</td>
<td>Incomplete immunization were attributed to remote area of residence (OR = 3.72, 95% CI 2.53 – 5.49), distance to health facility (OR = 2.64, 95% CI 1.82 – 3.84), Mothers low education (OR = 3.38, 95% CI 2.30 – 4.97), Knowledge on EPI schedule (OR = 3.18, 95% CI 1.26 – 8.09), no religious beliefs (OR = 1.65 95% CI 1.15 – 2.36), Immigrant (OR = 4.33, 95% CI 1.81 – 10.47), home delivery (OR = 2.27, 95% CI 1.52 – 3.38) and civil status of mother (single, divorced or widow) (OR = 1.68, 95% CI 1.07 – 2.64). 1. Remote area of residence. 2. Distance to health facility. 3. Mothers low education. 4. Knowledge on EPI schedule. 5. No religious beliefs. 6. Immigrant. 7. Home delivery. 8. Civil status of mother.</td>
</tr>
<tr>
<td>Study</td>
<td>Methodology</td>
<td>Design</td>
<td>Sample Size</td>
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<tr>
<td>Johri et al., 2015 (India)</td>
<td>Self-administered questionnaire</td>
<td>Cross-sectional</td>
<td>n=1170</td>
</tr>
<tr>
<td>Khowaja et al., 2012 (Pakistan)</td>
<td>Guided questionnaire</td>
<td>Cross-sectional</td>
<td>n=1017</td>
</tr>
<tr>
<td>Kruger et al., 2013 (Tanzania)</td>
<td>Health data card</td>
<td>Cross-sectional</td>
<td>n=3868</td>
</tr>
<tr>
<td>Lakew et al., 2015 (Ethiopia)</td>
<td>Ethiopian health survey data</td>
<td>Cross-sectional</td>
<td>n=1927</td>
</tr>
<tr>
<td>Legesse &amp; Dechassa 2015 (Ethiopia)</td>
<td>Ethiopian health data</td>
<td>Cross-sectional</td>
<td>n=591</td>
</tr>
</tbody>
</table>
- those whose average walking time from home to health facilities is less than an hour (AOR = 3.1, 95% CI 1.5 - 6.3),
- those who had ever discussed about immunization with health extension workers (AOR = 2.4, 95% CI 1.3 - 4.2) and
- mothers’ with sufficient knowledge on immunization (AOR = 2.5; 95% CI 1.5 - 4.2).

4. Walking time to health facility less than 1 hour.
5. Discussion with health extension workers.
6. Mothers sufficient knowledge on immunization.

<table>
<thead>
<tr>
<th>Study</th>
<th>Methodology</th>
<th>Study Design</th>
<th>Sample Size</th>
<th>Associated Factors</th>
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</thead>
<tbody>
<tr>
<td>Mohamud et al., 2014 (Ethiopia)</td>
<td>Ethiopian health survey data</td>
<td>Cross-sectional</td>
<td>n=582</td>
<td>Maternal literacy (AOR = 3.06, 95% CI 1.64 - 5.71), Tetanus Toxoid Vaccine (AOR = 2.43, 95% CI 1.56 - 3.77), place of delivery (AOR = 2.02, 95% CI 1.24 - 3.28), place of residence (AOR = 2.04, 95% CI 1.33 - 3.13), and household visits by health workers (AOR = 1.92, 95% CI 1.17 - 3.16), were found to be factors significantly associated with full immunization.</td>
</tr>
<tr>
<td>McCauley et al., 2012 (USA)</td>
<td>National telephone survey</td>
<td>Cross-sectional</td>
<td>n=1500</td>
<td>The factors identified for not following the immunization schedule were no confidence in the safety of the childhood immunization (AOR = 9.0, 95% CI 6.3 – 12.5), not comfortable with the number of vaccines for children under 2 years (AOR = 20.6, 95% CI (16.5 – 25.1).</td>
</tr>
<tr>
<td>Neguissie et al., 2016 (Ethiopia)</td>
<td>Structured questionnaire</td>
<td>Case-control</td>
<td>n=548</td>
<td>The incomplete immunization status of children was significantly associated with young mothers (AOR = 9.54; 95 % CI 5.03 – 18.09), being born second to fourth (AOR = 3.64, 95 % CI 1.63 – 8.14) and being born fifth or later in the family (AOR = 5.27, 95 % CI 2.20 – 12.64) as compared to being born first, a mother’s lack of knowledge about immunization benefits (AOR = 5.51, 95 % CI 1.52 – 19.94) and a mother’s negative perception of vaccine side effects (AOR = 1.92, 95 % CI 1.01 – 3.59).</td>
</tr>
</tbody>
</table>

1. Maternal literacy.
2. Received tetanus toxoid vaccine.
3. Place of delivery.
4. Place of residence.
5. Household visits by health workers.

1. No confidence in the safety of childhood immunizations.
2. Not comfortable with the number of vaccines.
3. Young mothers.
4. Being born 2nd to 4th.
5. Born 5th or later.
7. Negative perception on vaccine effects.
<table>
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<tr>
<th>Study (Year, Country)</th>
<th>Methodology</th>
<th>Study Design</th>
<th>n</th>
<th>Key Findings</th>
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<tbody>
<tr>
<td>Odusanya et al., 2008 (Nigeria)</td>
<td>Self-administered questionnaire</td>
<td>Cross-sectional</td>
<td>339</td>
<td>Factors associated with completion of vaccination were pharmaceutical company office conducting vaccination (OR = 30.39, 95% CI 14.12 – 65.42), satisfactory maternal knowledge on vaccination (p = 0.006), 1. Pharmaceutical company place of vaccination. 2. Satisfactory maternal knowledge on vaccination.</td>
</tr>
<tr>
<td>Odutola et al., 2015 (Gambia)</td>
<td>Health card survey</td>
<td>Cross-sectional</td>
<td>1154</td>
<td>Risk factors associated with the delay and incomplete immunizations were home delivery (AOR = 1.47, 95% CI 1.05 – 2.07), access to only public transport (AOR = 1.54, 95% CI 1.20 – 1.97) and being born as ≥2nd child or more (AOR = 1.37, 95% CI 1.04 – 1.79). 1. Home delivery 2. Access to only public transport. 3. Born as &gt;2nd child.</td>
</tr>
<tr>
<td>Otieno et al., 2014 (Kenya)</td>
<td>Questionnaire, Secondary data and primary observation</td>
<td>Cross-sectional</td>
<td>7249</td>
<td>Those living more than 5km from a healthcare facility were less likely to adhere to the immunization schedule (AOR = 0.70, 95% CI 0.54 – 0.91; p = 0.007). Parents aged 35-44 was more likely to adhere to the immunization schedule in comparison to those age less than 25 years old (AOR=1.36, 95% CI 1.15 – 1.62; p &lt; 0.001; and AOR=1.35, 95% CI 1.10 – 1.64; p = 0.003). Children that had a sibling hospitalized within one year prior to vaccine campaign were more likely to be vaccinated than children from households with no hospitalizations reported within one year prior to the campaign (AOR=1.73, 95% CI 1.40 – 2.14; p &lt; 0.001). 1. Far distance to healthcare facility. 2. Age. 3. Sibling with history of hospitalization due to infectious disease.</td>
</tr>
<tr>
<td>(Pati et al., 2011 (USA)</td>
<td>Self-administered questionnaire and pro-forma</td>
<td>Prospective Cohort</td>
<td>506</td>
<td>Non-compliant to the immunization schedule were due to high school education (AOR = 2.04, 95% CI 1.16 – 3.57). 1. High school education.</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Data source</td>
<td>Study design</td>
<td>Study size</td>
<td>Key Findings</td>
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<tr>
<td>Pearce et al., 2015 (Australia)</td>
<td>Secondary data</td>
<td>Cross-sectional</td>
<td>n=5107</td>
<td>Incomplete immunization factors were found to be those with larger families not using formal childcare (aRR = 2.49, 95% CI 1.72 – 3.62), ethnicity (aRR 1.73, 95% CI 1.03 – 2.91) and low education of mother (aRR = 2.22, 95% CI 1.22 - 4.04).</td>
</tr>
<tr>
<td>Riise et al., 2015 (Norway)</td>
<td>Immunization registry</td>
<td>Cross-sectional</td>
<td>n=63,382</td>
<td>Immigrant children were more frequently delayed 52.3 % vs. 43.1 %, (aRR 1.21, 95 % CI 1.19 - 1.24). Children scheduled for vaccines in the summer holiday month (July) were more frequently delayed than others (1(st) dose pertussis vaccine 6.5 % vs. 3.9 % (aRR 1.65, 95 % CI 1.48 - 1.85). Priming against pertussis (2(nd) dose), pneumococcal (2(nd) dose) and measles (1(st) dose) was delayed in 16.8, 18.6 and 29.3 % respectively.</td>
</tr>
<tr>
<td>Rossi et al., 2015 (Zimbabwe)</td>
<td>National registry data</td>
<td>Cross-sectional</td>
<td>n=1031</td>
<td>No tetanus vaccination for mothers during pregnancy (AOR = 2.1, 95% CI 1.5 – 3.0). Child living away from mother (AOR = 1.5, 95% CI 1.2 – 1.8). Mother’s education (AOR=0.6, 95% CI 0.4 – 0.9). High number of children living in the household (AOR=1.5, 95% CI 1.1 – 2.2).</td>
</tr>
<tr>
<td>Russo et al., 2015 (Cameroon)</td>
<td>Household survey with guided questionnaire</td>
<td>Cross-sectional</td>
<td>n=502</td>
<td>Factors significantly associated with incomplete immunization status were retention of immunization card (AOR = 7.89, 95% CI 1.08 - 57.37), lower mothers' utilization of antenatal care (ANC) services (AOR = 1.25, 95% CI 1.07 - 63.75), being the ≥ 3(rd) born child in the family (AOR = 425.4, 95% CI 9.6 - 18,808), younger mothers' age (AOR = 49.55, 95% CI 1.59 - 1544), parents' negative attitude towards immunization (AOR = 20.2, 95% CI 1.46 - 278.9), and poorer parents' exposure to information on vaccination</td>
</tr>
</tbody>
</table>

(AOR = 28.07, 95% CI 2.26 - 348.1). Longer distance from the vaccination centers was marginally significant (p = 0.05).

<table>
<thead>
<tr>
<th>Study</th>
<th>Data Source</th>
<th>Study Design</th>
<th>Sample Size</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shrivastwa et al., 2015</td>
<td>DLHS 3, National registry data</td>
<td>Retrospective Cohort</td>
<td>n=108,057</td>
<td>Children living in urban areas compared to rural areas had 1.8 times higher odds of non vaccination compared with full vaccination (OR=1.80, 95% CI 1.67 - 1.94), and 1.12 times greater odds of under-vaccination compared with full vaccination (OR=1.12, 95% CI 1.04 - 1.20). Muslim children had 2.2 times greater odds of being non-vaccinated versus fully vaccinated and 1.42 times higher odds of being under-vaccinated compared with fully vaccinated. Children born in private institutions had greater odds (OR=1.45, 95% CI 1.25 - 1.68) of non-vaccination compared with full vaccination. Children belonging to lower groups compared with privileged groups had 33% higher odds of non-vaccination compared with full vaccination and 12% higher odds of under-vaccination.</td>
</tr>
<tr>
<td>Shuaib et al., 2010</td>
<td>Health and clinic records – secondary data</td>
<td>Case-control</td>
<td>n=229</td>
<td>Participants with less than secondary school education were more likely to be non-compliant (OR = 2.51, 95% CI 1.06 - 5.97).</td>
</tr>
<tr>
<td>Singh et al., 2013</td>
<td>National Family Health Survey Data</td>
<td>Retrospective Cohort</td>
<td>n=3454</td>
<td>Religion was significantly protective with Muslim parents less likely to have their child fully immunized (OR=0.58, 95% CI 1.40 - 3.21). Women with high household decision-making were more likely to have their child fully immunized (OR=1.64, 95% CI 1.25 - 2.14). Women who believed that wife beating is not acceptable were also more likely to have their child fully immunized (OR = 1.47, 95% CI 1.16 - 1.85)</td>
</tr>
</tbody>
</table>

1. Urban area.
2. Religion (Islam).
3. Place of delivery in private hospital.

1. Low education.
2. Decision making mothers.
3. Empowered mothers.
<table>
<thead>
<tr>
<th>Study Authors, Year (Country)</th>
<th>Research Design</th>
<th>n</th>
<th>Sample Characteristics</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smith et al., 2010 (USA)</td>
<td>Self-administered questionnaire</td>
<td>2921</td>
<td>Parents who intentionally delayed were significantly more likely to have heard or read unfavorable information about vaccines than parents who did not intentionally delay (87.6% vs. 71.9%, p &lt; 0.05). Compared with parents who intentionally delayed only because their child was ill, parents who intentionally delayed only because of vaccine safety or efficacy concerns were significantly more likely to seek additional information about their decision from the Internet (11.4% vs. 1.1%, p &lt; 0.05), and significantly less likely to seek information from a doctor (73.9% vs. 93.9%, p &lt; 0.05).</td>
<td>1. Read unfavourable information on vaccine. 2. Vaccine safety or efficacy concerns.</td>
</tr>
<tr>
<td>Tarrant et al., 2003 (Canada)</td>
<td>One to one interview</td>
<td>28</td>
<td>Half of the participants (n=14) stated that the fear of the potential consequences of vaccine-preventable diseases would make them adhere to the immunization schedule. The majority of mothers (n=25) believed that having their children immunized prevented them from becoming ill and thus viewed immunizations as effective in preventing disease. The majority of working mothers (n=11) reported that it was usually not difficult to leave work for a short period to have their children immunized. 17 participants identified long clinic waiting times as a major barrier to immunization. Half of the participants (n = 12) reported that when their children were due for immunizations they were frequently ill.</td>
<td>1. Fear of disease. 2. Prevention of disease. 3. Time constraint. 4. Waiting time. 5. Illness.</td>
</tr>
<tr>
<td>Vikram et al., 2013 (India)</td>
<td>Secondary data from India DHS</td>
<td>5287</td>
<td>Increase in immunization between mothers who had finished upper primary school versus the illiterate (β = 0.477) was reduced by only 22% (β = 0.371) due almost equally to the human capital and cultural capital controls.</td>
<td>1. Low level of education.</td>
</tr>
<tr>
<td>Yenit et al., 2015 (Ethiopia)</td>
<td>Community based unmatched</td>
<td>308</td>
<td>Predictors of defaulting from completion of childhood vaccination were being delivered at</td>
<td>1. Delivered at home. 2. No antenatal care and</td>
</tr>
<tr>
<td>Misconception on vaccine contraindication.</td>
<td>AOR=4.113, 95% CI 2.263 - 7.475</td>
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<tr>
<td>Children born from mothers who had no antenatal care visit during pregnancy (AOR=2.549, 95% CI: 1.312 - 4.955)</td>
<td></td>
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<tr>
<td>Mothers/caretakers of child who had misperception on vaccine contraindication (AOR=2.834, 95% CI 1.558 - 5.156) and children born from mothers who had no Post natal care visit (AOR=2.512, 95% CI 1.184 - 5.330).</td>
<td></td>
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<tr>
<td>Low education.</td>
<td></td>
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</tbody>
</table>

3. Misconception on vaccine contraindication. 
4. Low education.
3.0 Result

The search 2382 results were returned of which 91 were relevant to this study after examining the full text. A purposeful approach was then pursued. Moving on bibliographic references and undertaking key author and grey literature searches proved as an effective complimentary approach to the original review and were reverted to the original search. This approach brought the total number of relevant full text result to 35. A major problem faced was the little quantitative and empirical evidence of local studies, which could be due to the limitations in availability of databases with wide scope. The Table 1 is a summary of the factors of adherence among mothers on under-five childhood immunization schedule. The studies adopted a variety of study designs to portray the factors of adherence among parents on under-five childhood immunization schedule and its associated factors.

3.1 Study Locations

The studies were conducted in various countries with Romania, Uganda, Greece, Cambodia, Mozambique, Tanzania, Gambia, Australia, Norway, Zimbabwe, Cameroon, Jamaica and Canada with 1 study respectively. Malaysia, Pakistan, Kenya and Nigeria contributed 2 studies with the USA and India with 4. The most studies were from Ethiopia with a total of 6 studies. The majority of the respondents were made up of respondents who were parents of children who were in the immunization schedule range. The studies focussed on the factors that determine the adherence of the respondents. The majority of the studies were mainly conducted in developing and third world countries as a result of poor immunization uptake and also major outbreaks of vaccine-preventable diseases occurring in their respective nations. This showed that the majority of researches were still attempting to determine the various key factors that have an impact on adherence in order to address the issues for the betterment of future health planning and programs. The factors of adherence among parents on under-five childhood immunization schedule cover various aspects. The majority of the factors can be divided in to socio-demographic factors of parents, socio-demographic factors of child, vaccine factors, logistic factors and other factors. This classification would enable a more systematic approach to the research being conducted.

3.2 Study Type and Respondents

The number of respondents varied with the smallest sample size being 28 and the largest being 108,057. The type of studies was 25 cross-sectional studies, 4 retrospective cohorts, 3 case controls, 2 qualitative and 1 prospective cohort.
3.3 Flowchart of the search strategy.

Figure 1: Flowchart of the systematic review process on the factors of adherence among parents on under-five childhood immunization schedule.

(n) Refers to Number.
3.4 Non-modifiable factors

Socio-demographic factors of parent, socio-demographic factors of child, maternal factors, logistic factors and administration factors were identified as non-modifiable factors in the review.

3.5 Modifiable factors

The modifiable factors identified were knowledge factors, vaccine factors, awareness factors and perception factors.

4.0 Discussion

The purpose of this systematic review was to identify the factors of adherence on under-five childhood immunization among parents. The review found that there were multiple factors that contributed to the adherence and they are categorized and discussed as follows.

4.1 Socio-demographic factors of parent

Age was found to be a factor by a number of studies particularly in reference to the age of the mother. Azhar et al (2012), Barbacariu (2014) Emmanuel et al (2015), Feemster et al (2009), Neguissé et al (2016), Otieno et al (2014) and Russo et al (2015) all found age of the mother to be a factor. It was noted however that the varying degrees or range of the age could be noted.

Azhar et al (2012) showed that the mother’s employment had a role in the adherence to the childhood immunization schedule. The study showed that those who were unemployed were more likely to not complete the immunization according to the schedule. Bugvi et al (2014) on the other hand found the significant association with the fathers’ occupation that showed those with employment were more likely to have their child complete the immunization schedule. Legesse and Dechassa (2015) were more specific with their study singling out farmers as those with this occupation to adhere to the immunization schedule. The studies invariably showed that those who were employed regardless of which parent, had a higher likelihood of having their child complete the immunization according to the schedule.

Ethnicity as showed by Pearce et al (2015) in the study conducted in Australia to be a significant factor to the adherence of the immunization schedule. The minority ethnic group were twice as likely to have incomplete childhood immunization. This was the only study from the review to show a significant association to ethnicity.

Studies from the review showed education as a major and consistent factor to the adherence to the childhood immunization schedule. Those with low education were more likely to not adhere to the childhood immunization schedule as shown by Barbacariu (2014) with similar findings in the other studies conducted by Feemster et al (2009), Gidado et al (2014), Jani et al (2008), Pearce et al (2015), Shuaib et al (2010), Vikram et al (2013) and Yenit et al (2015). The study done by Rossi et al (2015) shows education itself as a factor. Education as demonstrated by the studies in the review was different according to region. However from
the results the majority agreed that the baseline of low education was those with secondary level education and below or its equivalent. No studies mentioned tertiary education or college thus the completion of secondary school respective to each country will be the minimum standard education level.

Another factor of adherence to childhood immunization schedule is income. Two studies in the review showed that the likelihood of those with low income are less likely to conform to the immunization schedule (Hong and Chhea, 2010) and (Lakew et al, 2015).

The study conducted by Feemster et al (2009) showed that parents who were smokers were more likely to not complete the immunization schedule. The relationship to the adherence is unclear with the likelihood of those who smoke to not have the strictest attitude towards good health to be a possible explanation.

Religion has been identified by studies to be a factor of adherence to the childhood immunization schedule. In particular the religion Islam has been identified as seen in the studies conducted by Singh et al (2013). Religious beliefs itself was shown to be a factor by Jani et al (2008) with those with no religious belief to be twice as likely to not complete the childhood immunization schedule. This two studies show that religion itself is a factor but not having any religious beliefs may also produces the same outcome. Islam in particular is important to note as a factor as the majority of Malaysian are predominantly Muslim. The cross between religion and science has always showed to be a barrier for certain populations.

The civil status of the mother has been identified by Jani et al (2008) as a factor of adherence. Civil status was defined as either single, divorced or a widow with this group being twice as likely to not follow the childhood immunization schedule. The most plausible reason would be the difficulty of time management in being a sole parent.

The number of children the mother or woman has also been found to be a factor to adherence. Azhar et al (2012) found that those who had multiple children (more than 3) were four times more likely not to adhere to the childhood immunization schedule. This was also supported by the study done by Babacariu (2014). In Uganda baburye et al (2012) found that those with multiple children were twice as likely to have low adherence to the immunization schedule and this was similar to the findings by Feemster et al (2009) in the United States of America. Pearce et al (2011) in Australia and Rossi et al (2015) in Zimbabwe also found it to be a factor.

4.2 Socio-demographic factors of child

Age of the child was found to be a factor by Emmanuel et al (2015) in the study conducted among 183 respondents. Those who were less than 18 months of age were four times less likely to have completed the immunization schedule. This is however only found in one study in the review and may not be easily generalized to other geographical locations.

The birth order of the child has also been identified in several studies in the review as a factor. Neguissie et al (2016) showed that being born 2nd to 4th meant that the child was four times less likely to complete the immunization schedule and being born 5th or higher was more than five times likely to fail to complete the childhood immunization schedule. Similarly Odutola
et al (2015) and Russo et al (2015) also found the same results with minimal difference in the likelihood.

A factor that was shown by multiple studies in the review was place of delivery of the child. Studies from various locations revealed that where the child was born highly determined the likelihood of a complete childhood immunization schedule. Babirye et al (2012), Bugvi et al (2014), Etana and Deressa (2012), Jani et al (2008) Mohamud et al (2014) Odutola et al (2015), Shrivastwa et al (2015) and Yenit et al (2015) all showed that those who were delivered at home and not in a public or private health care facilities were more likely to not adhere to the childhood immunization schedule.

The post natal check-up of the child is also a factor as identified in the study by Bugvi et al (2014) that showed those with non-use of antenatal care were more likely to not follow the immunization schedule and similarly also in the studies done by Etana and Deressa (2012), Feemster et al (2009), Legesse and Dechassa (2015) and Yenit el al (2015) all found the same likelihood factor.

A child with a history of another sibling who has been hospitalized has also been noted to be a factor of adherence to the childhood immunization schedule. Otieno et al (2014) showed that those who did were twice as likely to adhere to the childhood immunization schedule. The history of another sibling with a vaccine preventable disease could be the prompt to ensure that future siblings receive adequate vaccines thus adhering to the childhood immunization schedule.

Those who did not live with their birth mother were also twice as likely to fail to follow the childhood immunization schedule (Rossi et al, 2015). This is an important factor as many urban families live with parents or have a caretaker for their child.

4.3 Administrative Factors

Administrative factors are those that involve the key stakeholders such as the health care providers, workers and staff. These factors are modifiable but may not necessarily be easy to overcome. Those who had home birth were less likely to have home visits thus limiting the ability of the child to be given the required vaccine as shown in Etana and Deressa (2012) with those who had home birth less likely to receive a health care home visit by a registered community nurse. Mohamud et al (2014) found that those with home visits were twice as likely to have full compliance to the immunization schedule.

In places where the immunization card is also retained by the health clinic the likelihood of the failure to follow the childhood immunization schedule was eight times more than those who were allowed to keep the immunization card (Russo et al, 2015).

Children who received low skill staff in their delivery was more likely to not adhere to the childhood immunization schedule (Kruger et al, 2013). This could be due to the lack of information transfer from health care staff to the mother regarding the necessity and importance of adhering to the childhood immunization schedule.

Kruger et al (2015) also showed that the interruptions of monthly clinics was also a major factor with it being ten times more likely to have fail immunization compliance when the
clinics had multiple interruptions. The most likely reason can be confined to the inability of parents to keep rescheduling immunization appointments.

The lack of vaccines in health centres has also been identified as a factor that results in twice the likelihood of failed immunization schedule compliance (Kruger et al, 2013).

The effect of staff in administering vaccines is one that requires trust. As shown in the study done in Nigeria by Odusanya et al (2008), the likelihood of compliance to the childhood immunization schedule was thirty times more likely when a reputable pharmaceutical company provided the vaccine shots instead of the regular health district clinics. The mistrust in the health care system may discourage potential compliant recipients from adhering to the childhood immunization schedule.

4.4 Logistic Factors

Studies from the review have shown that logistic has been attributed to the adherence on childhood immunization. Those who live in remote areas were more likely not to comply to immunization schedule and Jani et al (2008) showed that there were 4 times less like to do so. Johri et al (2015) also found it to be a factor as well for those rural site and remote housing areas. This in turn affects the number of children who follow the immunization schedule. The distance of health care facilities also play a role as Jani et al (2008) and Otieno et al (2014) showed that those with considerable distance to a facility were less likely to follow the immunization schedule. Another important factor was access to public and private transport. Legesse and Dechassa (2015) showed that those who had to walk more than 1 hour to the health facility were more likely to fail to follow the childhood immunization schedule. Odutola et al (2015) showed that those with no private transportation and had only access to public transport were twice as likely not comply with the immunization schedule. Various reasons are provided but the main factor is the convenience of private transport in comparison to having to either walk or utilize public transportation with a child along.

4.5 Vaccine Factors

One of the main reasons for not adhering to the immunization schedule is misunderstanding of the vaccine itself. The vaccine effects where parents felt would overload the immune system of their child were a worrying reason (Babacariu, 2014). The number of vaccines to be received by children under 2 years old was also not comfortable for parents and those who felt this were 20 times more likely to not adhere to the childhood immunization schedule. The reason may be a combination of both the factors as parents are unsure of what is actually suitable to be received by the child. This is further enforced when there is misconception on the vaccine contraindications as shown in Yenit et al (2015) where presence of misconception resulted in three times more likely failure to comply to the childhood immunization schedule.

4.6 Knowledge on Vaccines

The information and knowledge on vaccines is important as it allows the parents to understand the entire purpose of the childhood immunization program. Knowledge was found to be a factor by Awadh et al (2014). The knowledge on age of vaccination is also a factor where those who knew the age were three times more likely to adhere to the schedule (Etana and Deressa. 2012) and those who had further knowledge on the completion of the vaccine
age were four times more likely to comply. Furthermore knowledge on the EPI schedule resulted in three times more likely compliance to the childhood immunization schedule (Jani et al, 2008). The knowledge on vaccines plays a pivotal role in the ability of the parent to comprehend the importance of adhering to the childhood immunization schedule. As Neguissie et al (2016) showed those with lack of knowledge on vaccines were six times more likely to fail to comply with the schedule. Tarran et al (2003) those who had knowledge that vaccines could prevent disease and also limit illness to the child were more likely to adhere to the schedule. Knowledge regarding childhood immunization schedule, its vaccines, its effects and the diseases that may be prevented is important in allowing the parents to make informed and sound decisions in regards to immunizing the child. Further knowledge on the timeliness of vaccines also enables the child to receive the required immunizations according to the set schedule. However from the studies it can be seen that those who have deep understanding and knowledge are respondents from developed countries and those with low knowledge are from third world or developing nations.

4.7 Awareness on Vaccines

The awareness on vaccines is also important in ensuring the adherence to the childhood immunization schedule. Health community programs aims to ensure that all key stakeholders are aware of the immunization programs present. In parents who have awareness of community conversation programs they were twice as likely to follow the childhood immunization according to schedule (Lakew et al, 2015).

4.8 Perception on Vaccines

The perception of parents to the vaccine also plays a pivotal role in ensuring adherence. Studies showed that parents who perceived benefits of vaccination were more likely to follow the immunization schedule (Barbacariu et al, 2014). However in contrast those who had perception of natural immunity were twice as likely not to comply to the immunization schedule (Dannis et al, 2010). Parents who had no confidence in the in the safety of childhood immunizations were also nine times more likely to default the immunization schedule (McCauley et al, 2012) and similarly those who had a negative perception on vaccine effects were twice as likely to fail as well (Neguissie et al, 2016). In Tarran et al (2003), those who had the perception that vaccination would take a lot of waiting time were also less likely to get their child immunized. The perception of parents who make decisions is very important to consider, as they are responsible in making sound judgement for another human individual. Ensuring that the factors of perceptions are addressed would enable decision makers to adhere to the childhood immunization schedule.

5.0 Conclusion and recommendation

The systematic review identified various factors that influence adherence of parents on under-five childhood immunization schedule. Overall the factors were classified into two major groups, modifiable and non-modifiable factors. There were then segregated further into groups. The non-modifiable factors (knowledge, vaccine, awareness and perception) were identified as having a direct relationship with the adherence of the parents. Nevertheless the
multiple factors and results obtained from this systematic review will enable the researchers to further understand and develop necessary programs in order to address the issue of adherence. There are however still a few areas where recommendations could be made in relation to these findings. National budget and health policies could be one of the possible factors that affect the adherence. Attention should be given to non-modifiable factors for future parents where there may still be time for intervention to occur, such as suggesting place of delivery and also ensuring the understanding of the parents prior to having a child is met. Future research should be conducted to address and implement a health intervention program that integrates the various factors identified in this systematic review and to study its outcomes.

**Declaration**

We the authors declare that there is no conflict of interest regarding the publication of this article.

**Authors contribution**

Author 1: Principal reviewer
Author 2: Principal researcher
Author 3: Co-reviewer

**References**


