

# A cross-sectional study on pain perception toward needle-free injections in Gujarat state, India

Himarshi Trivedi,<sup>1</sup> Aditya Baviskar,<sup>2</sup> N Rajesh Kumar  
Department of Pharmaceutical Management

National Institute of Pharmaceutical Education and Research (NIPER), Ahmedabad-382355, Gujarat  
E-mail: rajesh.nadiminti@niperahm.ac.in

**Aim:** Main purpose of study was to understand awareness and preference related to needle free injection in Gujarat. Hypodermic needle related different dimensions were evaluated like fear, pain, inconvenience, side effects and reasons behind side effects and how they create avoidance of therapies by people. Study focuses to describe whether people are aware about needle free injection (NFI) and how much they are willing to use such device as alternative device to needle based injection. This conclusive cross-sectional study uses simple non convenient random sampling techniques were 390 respondents from 12 year to 55-year age group were selected who have once been administrated with needle injection in their life span, hence their perception can be known. An online structured surveys form was created. The data were analysed for descriptive analysis (mean, standard deviation), factor analysis (dimension reduction), and model building and structural equation modelling using the analysis of moment software. The association between gender and injection fear was evaluated using chi-square test ( $p < 0.05$ ). Key findings reveal that factors such as fear of injection, injury risk, awareness of needle free injection, and preference have a significant impact on people's perception of needle free injection. Factors related with needle pain perception raise awareness questions among people, thinking about an alternative. Pain (66.8%) is the biggest reason for negative perception of needle injection. NFI is unfamiliar to 48% of respondents. A total of 81.1% of people prefer NFI as an alternative to needle-based injection. There is high preference and moderate awareness of needle free injection among people of Gujarat. The NFI survey may help doctors, nurses, and other medical professionals to comprehend the rationale and necessity for incorporating needle-free injection into routine practices and large vaccination programme. Additionally, pharmaceutical companies will know about NFI market's potential for growth and patient centric approach.

## Introduction

### A. Background to study

Needle procedures are regularly performed on both healthy and chronically ill people throughout their lives. Some medical equipment is used on a regular basis on a worldwide scale since it is so important in nursing and medicine. One such device is a hypodermic needle or injection. Approximately 16 billion injections per year are administrated worldwide.<sup>1</sup> It is used for drug delivery into dermal, vascular, intramuscular, subcutaneous, and other various tissues. Injections are widely used in health care settings such as hospitals, and community centres serving as both home and health clinics for individuals with disabilities. Intramuscular and intradermal routes are frequently used in clinical practices.<sup>2</sup>

There are various psychological aspects related to needle insertion by which the patient is affected.

**KEY WORDS:** Injection, Needle fear, Needle-free injection, Painless, Perception.

One such emotion seen in individuals who may fear pain, discomfort, or fainting is a fear of needles or worry, and other side effects such as redness, swelling, observing needle size, lumps, and other issues.<sup>3</sup>

The related fear and avoidance may have a negative impact on critical aspects of patients' lives, including as their ability to choose a career, and get necessary medical treatments, such as self-injected insulin for diabetics.<sup>4</sup> There are various drawbacks related to needles shown in Figure 1.

The limitation of needle-based injection is that psychological fear related to resistance to self-injection.<sup>5</sup> The need for novel drug delivery technology is growing all the time. Needle Free Injection Technology has attracted a lot of interest as a way to solve several challenges associated with needle-based injections.<sup>6</sup>

- Injections without needles are painless.
- They do not cause any side effects.
- They are easy & fast to use.

## Research Article

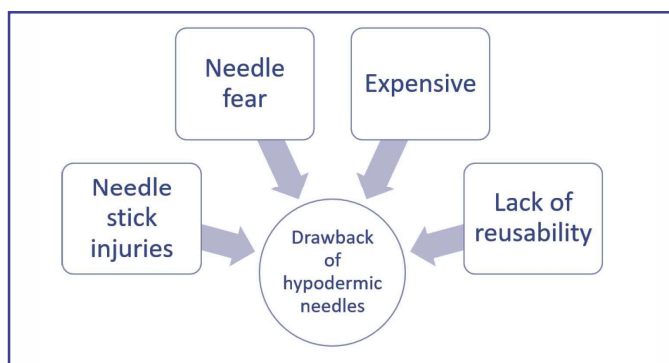


Figure 1. Drawback Related to Needles.

- Safe alternative for needle injections.
- Improve bio-availability over alternative non-invasive drug delivery systems by providing fast delivery and reprehensibility comparable to needles and syringes.
- Devices are available in reusable forms.

This method was first time documented in the 19th century in France, by H Galante produced an instrument called "aqua puncture". It was commercialized in the 1960s in the United States. Patients dislike needles, also healthcare professionals are concerned regarding accidental needle stick injuries, and pharmacy firms are looking for various novel ways to distribute their medicines.<sup>7</sup> PowderJect Pharmaceuticals was the first to design needle-free injections for powder medications. In addition, to avoid the need of needles, the method allowed a drug to be administered in solid dosage form, which improved the product's stability along with allowing it for controlled release.<sup>8</sup>

This technique works by forcing fluids via a tiny aperture against the skin at a high speed. This results in an ultra-fine jet of high-pressure fluid that penetrates the skin without any need of a needle.<sup>9</sup> These technologies were created to inject liquid formulations as well as solid dosage forms and vaccinations.

Needle-free medicine delivery is beneficial for a variety of reasons, including improved safety, increased compliance, reduced pain at the injection site, and easy and faster delivery of medicine.<sup>10</sup> There are several different kinds of NFIs include Ojector, cool click, Vita jet and others are available in market.<sup>11</sup> Manufacturers are attempting to create technology that can deliver more types of drugs in addition to ones that are safer and simpler to use.

The market's primary growth drivers include the rising prevalence of chronic diseases, an increase in the frequency of communicable diseases brought on by needle stick injuries, the increased demand of self-injection devices and bio-similar as well as the

benefits of novel drug delivery technology.<sup>12</sup>

The most difficult aspects of patient care have been identified as fear and discomfort and they can be barrier to successful treatment.<sup>13</sup> Needle Free Injection Technology (NFIT) has attracted a lot of interest as a way to solve several problems associated with needle-based injections.<sup>14</sup> World health organization and the Centre for Disease Control (CDC) are among the organization that promotes NFI.<sup>15</sup> Needle-free devices offer a number of benefits, including increased patient compliance, reduced injection site pain, and easier and faster drug delivery. Not only in the pharmaceutical industry, but this technology is also helpful in mass immunization programs, reducing the likelihood of needle stick injuries and other issues brought on by repeated use of a single needle.<sup>16</sup> A survey to analyse the perception of injections among healthcare seekers is required to appropriately address this problem.

We conducted a survey understanding people perception of needle fear, various reasons for needle fear, major side effects experienced, and avoidance of treatment due to same. Apart from this, survey includes respondents' awareness towards Needle free injection and awareness on parameter like painless delivery, ease and use convenience and market availability. An educational video regarding technique and knowledge was kept in Google form circulated for collecting responses to make the unaware respondent aware about NFI technology. Further phase of study was asked regarding their preference for NFI over needle injection, perception of usage in children for various therapies and as overall usage alternative to needle.

### Gap analysis

The related fear has a negative impact on critical aspects of patients' lives such as:

- Avoidance of necessary medical treatments
- Delay in therapy initiation
- Vaccination avoidance (studies show that 50% of adults faced fear while vaccinating and 11% of Indians avoided vaccine due to needle fear in 2021.<sup>17</sup>
- Resistance towards self-injection.

Therefore, there is must need for some alternative to needles.

### B. Why there is a need for study?

- Patients have a fear of needles.
- Patient suffers from different complications related to injections.
- Because needles are used so frequently in

professional settings, it's necessary to know who's at risk for needle phobia and what the consequences are.

- To understand patient awareness about alternatives to injection or what can be the scope of needle-free devices in the future.

### **C. Aim of Study**

To study pain perception of people towards needle-free injections in Gujarat state.

### **D. Objectives**

1. To understand physiological and behavioural variables in patient mind for fear, pain or side effects due to injection administration.
2. To understand Awareness of needle free injection among different age population.
3. To understand the willingness of people to prefer needle-free injection as an alternative to needle injections.
4. To check the future scope of needle-free injection in terms of factors like cost effectiveness, and self-administration.
5. To understand significant variables that has perception of people towards needle free injections.

### **Literature review**

Both the terms "needle fear" and "needle phobia" refers to anxiety which is related to the use of needles and scenarios involving injections use in practices. That needle, the phobia is defined as more psychiatric disorder than simple generalized fear in the Diagnostic and Statistical Manual of Mental illnesses. The research by McLenon and Rogers, 2019<sup>18</sup> yielded that needle fear was common to those who were undergoing blood donation, puncture in vein and patients with long term diseases need alternate injection. Hence, research gives direction towards gap analysis that why there is requirement of needle free injection for self-administration to chronic therapy patients along with fear being most common cause.<sup>18</sup>

According to a study, there was a considerable difference in correlation between injection and associated fear to get any injection treatment while being a patient. The authors recommended that anxiety and fear might influence health promotion behaviours to improve health and access to medical care, and also could affect procedures for detecting diseases and blood donations, by either reducing care seeking for people or by causing avoidance to care. Hence, a significant issue for services in clinical or preventive practice is due to needle anxiety or blood-related injury-injection phobia.<sup>19</sup>

According to an evaluation of ten key regions by WHO, each person in those areas received an average of 2 to 11 needle injections annually. Injections are among the most frequently performed medical treatments and are essential for both prevention and treatment. Even so, the fear of needle lead to delay in avoidance of preventive actions like vaccination, blood donation, and vein puncture while doing a normal clinical assessment and prescribing the appropriate care for various acute and chronic illness situations. From article John Yelland shows that most nations around world have seen improvements in injection procedures, still further efforts are needed to eliminate unsafe practices in healthcare settings. Needle free can be one such approach to eliminate unsafe practices.<sup>20</sup>

A research study that tries to understand the relationship between needle avoidance, vaccination intention (VI), and vaccination fear (VF), as well as reasons for avoiding vaccination (RAV). This relationship was found positive for these factors RAV and VI, but negative for VI with needle phobia. The findings are addressed and steps to decrease Vaccination fear (VF) and increase vaccination intention (VI) are advised. Malas and Tolsá 2022 study concluded that needle phobia is one of the major reasons behind vaccination administration.<sup>21</sup>

A short study on paediatric patients' pain tolerance to various dental operations under anaesthesia was compared using a vibrating needle and a traditional syringe. A statistically significant difference in visual analogue scale (VAS) and face pain rating scale (FRS) was discovered between the two procedures, but when physiological indicators like heart rate, blood pressure, and temperature at different intervals were examined. Findings demonstrate, Vibraject because less discomfort and pain while administrating local anaesthetic injection as compare to traditional injection. Reference study of Chaudhry, 2015 helps author to give more insights about how NFI device and traditional injection have significant impact on pain perception. As well as such studies motive author to understand more from society on needle free device awareness, usage, and preference to alternatives.<sup>22</sup>

McMurtry in his paper present an overview of discomfort and apprehension in relation to needle procedures. Few people consider this pain as minor pain but for others, these needles are not just a poke. While compared to adults, children have more anxiety about needle pain and desire to get therapies at lower pain intensity levels. Needle procedures like vaccine injection are common across the life, commonly in childhood. Across the lifespan,

# Research Article

people report an absolute increase of about 10% in willingness to receive a vaccination if treatment is painless. The emotional after effects of the experience can remain long after the sharp pain has subsided. Unrelieved discomfort might eventually lead to fear, which can lead to suffering during subsequent treatments.<sup>23</sup>

Liquid jet injector administers vaccine to dermal, subcutaneous, and muscle areas. The process of ballistic inoculation involves injecting vaccinations into skins outermost layers as in powder form. It has become common practice to use powdered lidocaine to deliver quick local analgesia to the back of the hand. Literature views about needle free injection mechanism, types and advantages are explained in article.<sup>24</sup>

## Methodology

A Conclusive, descriptive cross sectional research design study was conducted from 3rd December, 2021 to 9th December, 2021 with age group of 12 to 55 years old from state of Gujarat, India. By keeping in mind, the people of Gujarat who have once been administrated any medication with hypodermic needle in their life time are selected as relevant respondents for research study. Collectively 390 responses were collected by adopting non-convenient random sampling technique. An online Google based research questionnaire was circulated by various social media applications to people living in different districts of Gujarat. A total of 401 responses were collected, but out of that 390 have taken hypodermic needle at least once in their life time hence were sorted for data analysis. Remaining 11 responses were not taken in data analysis. A total of 390 data was collected for doing analysis. Data was analysed using SPSS V 23. Continuous variables were summarised using mean and standard deviation whereas categorial variables were done using frequencies and percentages. Prior to the survey, all respondents were informed that the information will be kept confidential. Prior to study, each responded gave their consent also. Referencing Hair<sup>25</sup> discussion with a view to the application of confirmatory factor analysis (CFA) and SEM structural equation modelling. The authors conclude that this sample is sizeable. This sample is considerable as per the authors' opinion by refereeing the discussion presented by Hair, 2019 with a view to the application of CFA and SEM.

## Data Analysis Plan:

1. Data preparation: Data entry into Excel, SPSS V23 data files preparation
2. Data Cleaning: Fill-up missing data points, removal of incomplete cases
3. Model building

4. Descriptive statistics with necessary graphs and statistics for gender, age, income level, healthcare professional and area are indicated by frequency (number of respondents) and percentage out of 100 in table 1. (Q 1 to Q 5 described under questionnaire design).
5. Exploratory factor analysis (EFA) -varimax rotation (Q6 to Q20 described under questionnaire design).
6. Confirmatory factor Analysis (CFA) -significant value 0.05 and confidence interval level 95%, Hair and babin, 2019 method taken maximum likelihood estimation (MLE) (for Q6 to Q20 described under questionnaire design). This study uses Principal Component Analysis (PCA) in SPSS V20 utilising varimax rotation to determine the underlying element and perception of needle-free injection. Four significant factors were as a result extracted. These four elements were determined to be needle injection awareness; needle injection preference, needle injection fear, and needle injection harm risk. In order to confirm the underlying findings, confirmatory factor analysis was carried out. CFA was employed to the measure construct of validity. Confirmatory Factor Analysis (CFA) is one of the most widely used techniques for evaluating the construct validity of an instrument, Hair et al, 2019. In comparison to Exploratory Factor Analysis (EFA), this method also provides a more accurate interpretation of dimensional data, Diana.<sup>26</sup> SEM technique was used in this work in examine the hypotheses. To determine whether the gathered data fit the suggested model, model fit analysis must be performed prior to testing the association, Hair, 2019. Maximum likelihood estimation is used for SEM-AMOS estimation.<sup>27</sup>
7. Reliability and validity check

**I. Study design:** The major study is conclusive cross sectional in nature. It is primary research which includes 20 close ended questionnaires. Data was collected from people with age group between 12 years to 55 years old.

**II. Sample size and sample technique:** The data was obtained from 390 respondents. The method used for collection of samples was convenient non-random sampling through an online survey. By refereeing the discussion presented by Hair and Babin, 2019<sup>25</sup> with a view to the application of SEM and CFA. Considering the summary of discussion (as provided below points) on the ideal sample size suitable for CFA and Communalities, the present research sample can be considered as adequate:

**III. Statistical test and Software used for statistical analysis and visualization:** Tools like Power BI, IBM SPSS V23, IBM AMOS V23 and Excel were used to perform statistical tests. The graphical dashboard in Figure 3 is created through Power BI. Factor analysis done for dimension reduction and chi-square analysis was performed through IBM SPSS tool. IBM AMOS software is used to study Structural equation modelling (SEM) and for model building. In excel various charts and numerical value such as percentages to each study was carried out, bar graph in Figure 4 was prepared using Excel 2019 version.

**IV. Procedure:** Firstly, a focus group study was conducted with 7 questions asked out of which 3 were open ended questions and other 4 questions were "yes" and "no" answered based questions asked to different age group. Total of 17 participants were asked about needle related fear and pain, avoiding treatment due to fear and pain while administration, awareness of needle free injection and preference to needle-

Size of sample minimum	No. of observed variable per factor	Communalities
100	3 and more	0.6 or more
150	3 and more	Modest level -0.5
300	<3 (few out of 7)	Lower level <0.45
500	<3 or equal to 3	Few with lower level

less injection as an alternative option of needle injections. Once the review obtained, 20 final questionnaires with different scales were prepared by doing literature review and circulated via Google form (online mode). The questions were asked regarding their perception to pain and other problem faced while administration of needle-based injection, awareness of needle free injection NFI and preference to NFI along with demographic questions like age, gender, healthcare professional, income level.

**V. Questionnaire design:** Close-ended questions were asked to respondents on the survey to look at their demographic profiles and Likert scale was used to record their comments on the factors that affect needle injection fear. The Likert scale has a maximum of five points, from one for strongly disagreeing to five for strongly agreeing and some awareness towards NFI were recorded on 5 scale where 1 being not aware at all to 5 being highly aware. A question asking "Have you ever taken injection before?" and 97.2% respondents answered "yes"- that they have experienced administration of hypodermic

needle, only those were selected as sample for target population for research. Finally, 390 responses were sorted for data analysis. Total of 20 questions were asked to respondents. I have mentioned that point in my questionnaire that I won't share this data or information provided by the respondents with any third party, this is solely for research purpose and in the possession of NIPER-A. I have kept the questions by carrying pure research intention in mind and this is not indulging any hurtful sentiments and beliefs of respondents from any group of people.

First five questions (Q.1 to Q.5) were on age, gender, income level, healthcare professional, belonging to urban or rural were asked to respondents. Next seven questions concerned or reaction to perception of needle-based injection about fear of injection before taking injection, pain perception while administration and side effects occur post injection effects were asked. Major parts of questionnaire were adopted from Siddiqui paper.<sup>26</sup> The researcher has developed the questionnaire by referring the literature on internet.<sup>27,28</sup> The data for first 6

questions has a 5 point scale with following options: 1 highly disagree, 2 for disagree, 3 for neutral, 4 for agree and 5 for strongly agree.

Q.6 Do you experience any fear/anxiety for needle before taking injection?

Q.7 Do you experience any type of pain while taking needle injection?

Q.8 Do you feel inconvenience while taking injection? (Place of administration, etc)

Q.9 Do you think that needles present in injections can be risky to cause injury?

Q.10 Do you experience any side effect after taking injection?

Q. 11 What are the reasons for needle fear? (Multiple selection option was asked for 7th question: Pain, watching needle, Nurse discussing with other about injection, seeing size of needle, observing other people getting vaccinated, previous bad experience).

Next four questions were asked about the Awareness of people towards Needle free injection. The Likert scale point for this awareness question were as 1- Not Aware at all, 2- Unaware, 3- Neutral, 4- Aware, 5- Extremely Aware.

Q.12 Needle free injection does not cause any pain.

Q.13 Needle free injections do not cause any side effects.

Q.14 Needle free injections are easy & fast in use

# Research Article

and safe alternative for needle injections.

Q.15 Are you aware about various needle free injections available in market? (E.g., Pharma JET, Cross jet, etc)

To get the insights on willingness of people to prefer needle free injection as an alternative over needle injections & its scope in market following next five questions were asked as follow. Five pointer Likert scale of 1 to 5 as above.

Q.16 Would you prefer Needle free injections if they are available for all range of disease therapies?

Q.17 Would you prefer needle free injections if they are cost effective than needle injections?

Q.18 Would you feel free to recommend needle free injections for children's therapies?

Q.19 Do you feel needle free injections are user friendly for self-administration (e.g. - Insulin)?

Q.20 Would you prefer needle free injections as an alternative over needle injections?

## Research hypothesis

**Null hypothesis:** There is no association between fear of needle, injury risk, awareness to NFI, preference to NFI perception towards NFI among people and

**Alternative hypothesis:** There is association between fear, risk to injury, awareness to NFI,

## Research hypothesis

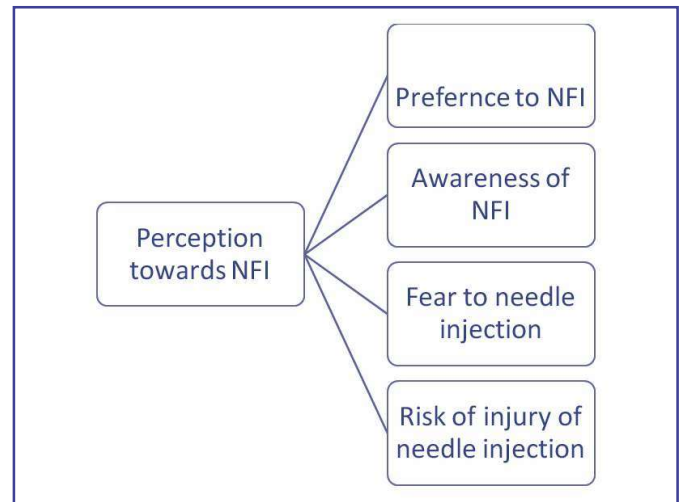


Figure 2. Hypothesized model.

preference to NFI and perception towards NFI.

Major objective of this paper is to check the usefulness of the CFA in order to test the fitting of a predesigned theoretical model. This is a study to understand how different estimation methods of CFA should be considered to fit the theoretical model on the data.

## RESULTS & DISCUSSION

The numbers of individuals recruited for research study are 390 living in Gujarat state.

### a . D E M O G R A P H I C PROFILES:

Table 1 displays some demographic data for the population, including gender, age, region, healthcare professional and income level and preference to needle free injection over needle injection administration choice.

From 390 respondent people from 12 year to 55-year age group all have participated in study. The survey was conducted to understand people perception of fear of injection which shows, 45.1% feels they have anxiety before taking injection. And at last, when preference was taken for Needle free injection over needle injection 81.1%

Table 1. Demographic Profile

VARIABLE	CATOGORY	FREQUENCY	PERCENTAGE
Gender	Male	196	50.3%
	Female	194	49.7%
Healthcare professional	Yes	185	47.4%
	Not healthcare professional	205	52.6%
Income level	No income yet	147	37.7%
	< 50,000 INR	66	16.9%
	50,000- 2,50,000 INR	49	12.6%
	2,50,000-5,00,000 INR	58	14.9%
	5,00,000-10,00,000 INR	47	12.1%
	>10,00,000 INR	23	5.9 %
Area	Urban	294	75.4%
	Rural	96	24.6%
Do you experience fear/anxiety before taking injection?	Agree	176	45.1%
	Neutral	107	27.4%
	Not agree	107	27.4%
Would you prefer needle free injection as alternative to needle injection?	Agree	319	81.8%
	Neutral	34	8.7%
	Disagree	37	9.5%

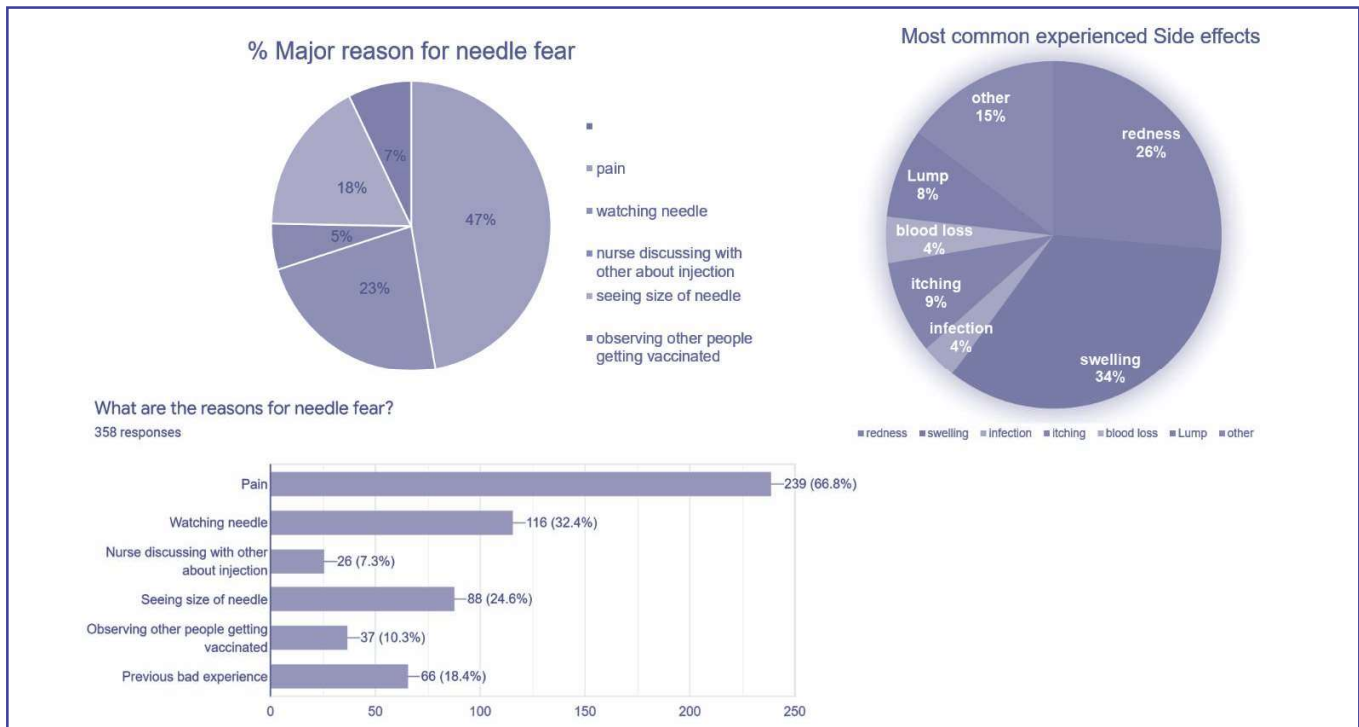


Figure 3. Needle fear related reason analysis.

want to have NFI in their treatment way option. People's perceptions toward pain, fear, and other aspects of administering injections with needles: figure 3 indicates various reason of needle fear as shown pain, watching needle followed by size of needle are major reason why people fear of injection and which ultimately affect therapy or healthcare of patient. When asked for most frequent side effects, pain (47%) being major one, followed by nurse discussing with other about injection (23%). Graphical represented dashboard was created using power BI represent that there are various problems like pain, seeing size of needle, and other responsible for fear to injection.

Figure 4 shows that from total number of those respondents who do not belong to healthcare profession (205), out of them only 32% know about NFI, while rest have no clue to this device. From them 77% wants to prefer NFI as they find it effective alternative to needle-based injections. Similarly, total number of healthcare professional participated in study (185) out of which only 38% are aware about NFI, hence, there is high requirement that a proper awareness of NFI among healthcare professional is also required. Those having healthcare professionals background from them 87% wants to prefer NFI as alternative to injections.

Association between gender and avoidance of treatment (Pearson Chi-square test):

**Hypothesis**

Ho: There is no association between being gender and avoidance to treatment.

H1: There is an association between gender and avoidance to treatment.

Statisticians determine the probability of an event occurring (Probability value) by chi-square on basis of degree of freedom. The number of subjects that can vary independently, minus one, is the degree of freedom (n-1). Because we have two phenotypic classes, then degree of freedom is 1. The calculated chi-square value from our findings can be compared to the numbers in the table that correspond to the particular degree of freedom we observe. This will inform us whether the differences (between what we predicted and also what we actually witnessed) are caused by chance or whether our hypothesis or assumption can be confirmed. If calculated value of chi-square is higher than critical or tabulated values, then you reject your null hypothesis. Here, calculated value is 5.191 which is greater than tabulated value which is 3.841. Hence, Pearson chi-square t-value was found significant indicates there is association between gender and avoidance of treatment as shown in Table 2. Our null hypothesis is rejected. Females tend to avoid treatment more compare to males.

Perception and Preference Analysis: Figure 4 indicates graphical analysis of few important questions asked during survey. Here, 5 major criteria

# Research Article

were kept in mind while questionnaire designing and few questions related to each criterion were asked as indicated in Table 3.

## b. Data analysis:

As data is moderately normally distributed and the measurement type of all the chosen variables are ordinal (scale- notation in SPSS data- file), maximum likelihood estimation can be an appropriate method. With the help of SPSS V23 software, most of underlying variables were extracted using factor analysis, which was utilised to reduce large number of variables. Results from the remaining factors generated a reliable model, which was further taken into consideration for validity and dependability. To determine if the various data components are correlated with one another, the greatest likelihood estimation. In this type of analysis different variables are grouped together. In Table 4, all the variables above 0.5 are grouped together. Before factorization, the sample adequacy for performing factor analysis on data is evaluated using the Bartlett test and KMO (Kaiser-Mayer-Olin), as indicated in Table 3. The sample is sufficient for factor analysis based on the KMO's p-value of 0.843 (>0.7).

Bartlett's test of sphericity p-value is 0.000 which indicates that factors can be performed from sample data. 48% of data is normal; however, considering the importance of valuable data, the other non-normal data along with normal (total sample) is taken for factor analysis study.

The data having commonality of higher than 0.5, that will explain more than half of the variance.

The analyses were performed utilizing IBM SPSS V 23 software. In order to check for connections across latent factors and to identify which factors are impacting which variables in the predicted model, the factored data was then used to conduct confirmatory factor analysis in IBM AMOS V 23 software and structural equation modelling. To do this, the reliability of Cronbach's alpha<sup>25</sup> (Table-5) was examined. The alpha values are displayed above, and we may consider them satisfactory values, indicating that the factor analysis-based variable grouping is closely related to one another, and thus a good indication to conduct Confirmatory Factor Analysis (CFA)<sup>25</sup> and Structural Equation Modelling (SEM)<sup>25</sup> on determined data set. The proposed model was created using AMOS graphics to conduct the

CFA and show that it fits the data perfectly.

In order to test our research hypothesis, all endogenous and exogenous variables were properly entered into the hypothesized model created in AMOS graphics, along with error factors, even before variables were connected with arrows to test our research theory. When the analysis is finished, the factor loading number in arrows is checked and the following statistics were examined for model fit: TLI (Tucker Lewis Index), CFI (Comparative Fit Index) and RMSEA Root Mean Square Error, must be near to ideal.<sup>25</sup>

## Regression Weights/ Factor Loading (Group number 1- Default Model)

The above results were acquired by a study

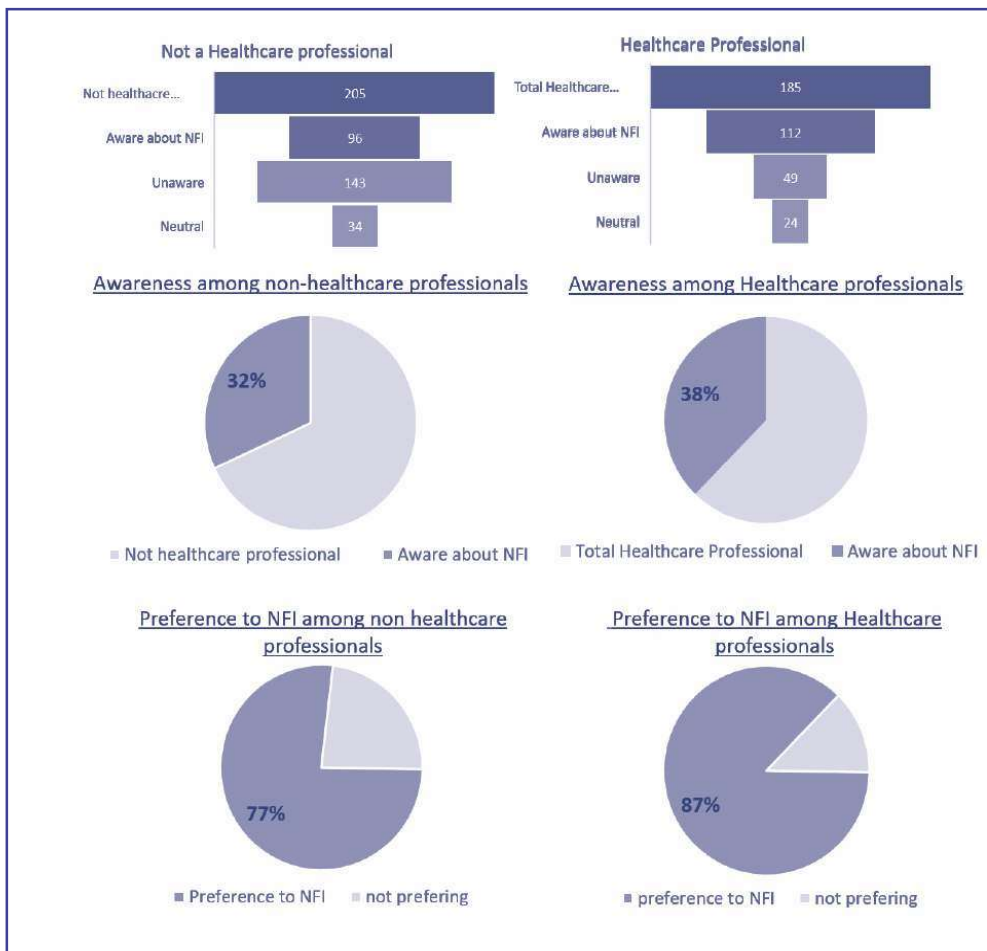


Figure 4. Profession-wise perception study.



Table 2. Pearson Chi-square test.

			A2		Total
			No	Yes	
G	Female	Count	129	65	194
		Expected Count	139.8	54.2	194.0
	Male	Count	152	44	196
		Expected Count	141.2	54.8	196.0
Total		Count	281	109	390
		Expected Count	281.0	109.0	390.0

P value	0.014984128
Alpha	0.05
Degree of freedom	1
Calculated chi-square	5.191833307
Tabulated chi-square	3.841458821

performed in AMOS (Analysis of moment structure), as shown in the table, there are variables that have a significant impact on each other (95% confidence), as the Probability value (P- value) (significance) is 0.001(in the Table 7 output it is represented as \*).<sup>25</sup> Originally for significance, the value of P should be < 0.05. Fear related factors such as side effects, pain, fear, and inconvenience during administration and risk to injury, similarly awareness towards NFI and preference of needle free injection shows significant impact on needle free injection perception.

**Goodness of Fit**

Goodness of Fit basically, it gives an indication of the fitting of the theoretical model. Higher the value of GFI (goodness of fit index) indicates the better fit of the theoretical model to the sample data. The static values of different model fit parameters obtained are Root means square error (RMSEA) 0.065

Table 3. Analysis.

Major Criteria	Perception	Strongly agree & agree out of total 390 samples (100%)
1. Before Taking Needle Injection	Fear before taking injection	45.1%
	Injury Risk Before taking injection	42.0%
2. While Taking Needle Injection	Inconvenience while administration	46.4%
	Pain felt while administration	61.8%
3. After Taking Injection	Side Effects Experienced after injection administration	28.4
4. Awareness to Needle free Injection (NFI)	Awareness to NFI	48% (not aware at all)
1. Preference to NFI	Preference to children’s therapies	84.6%
	Preference as alternative to Needle injection	81.8%

near to 0.06 said to be in the non-error range, Comparative fit Index (CFI) 0.938, TFI (Tucker Lewis Index) 0.926 and the CFI (Comparative Fit Index) is 0.938 signifies that the model has satisfactory results and is considered to be fit model. The probability level was significant (P= 0.001) at that level. The components having Cronhbach's alpha value which is greater than >0.7 and is regarded as "acceptable". Figure 5 shows the results of SEM (Structural Equation Modelling) in addition to this CFA (Confirmatory Factor Analysis).

AMOS was used to generate the mentioned in Table-8 results. It is evident that there are variables that have a significant relationship with each other because the P (significance) value is 0.001, showing 95 percent confidence.

The findings suggest that the Perception of people towards needle free injection has been impacted by Fear of needle injection, injuries related to them, which leads to awareness of NFI and preference of NFI.

**Generalisability (external validity)**

Convergence validity is the level of assurance in a feature that is well measured by its indicators, whereas discriminant validity is the level of assurance in measuring various qualities that are unrelated to one another. The degree of common variance shared among the implicit variables of the model is assessed using the Fornell-Larcker (1981) criterion in CFA. With Average Variance Extracted [AVE] and Combined Reliability, the measurement model's convergent validity can be assessed (CR-Composite Reliability [CR]). The acceptable range for both the CR and AVE is 0.70 and above, but 0.50 and above is sufficient. For the purpose of determining the discriminant validity, AVE> MSV (Maximum Shared Variance) criteria were used. The analyses in the table offer speculative conclusions about generalizability.

**Reliability: the CR for Injury is slightly less than 0.70.**

Convergent Validity: the AVE for Injury is equal to 0.50.

Discriminant Validity: the AVE for Injury is more than MSV.

Here, everything is in range, but reliability of injury to risk factor is slightly away from

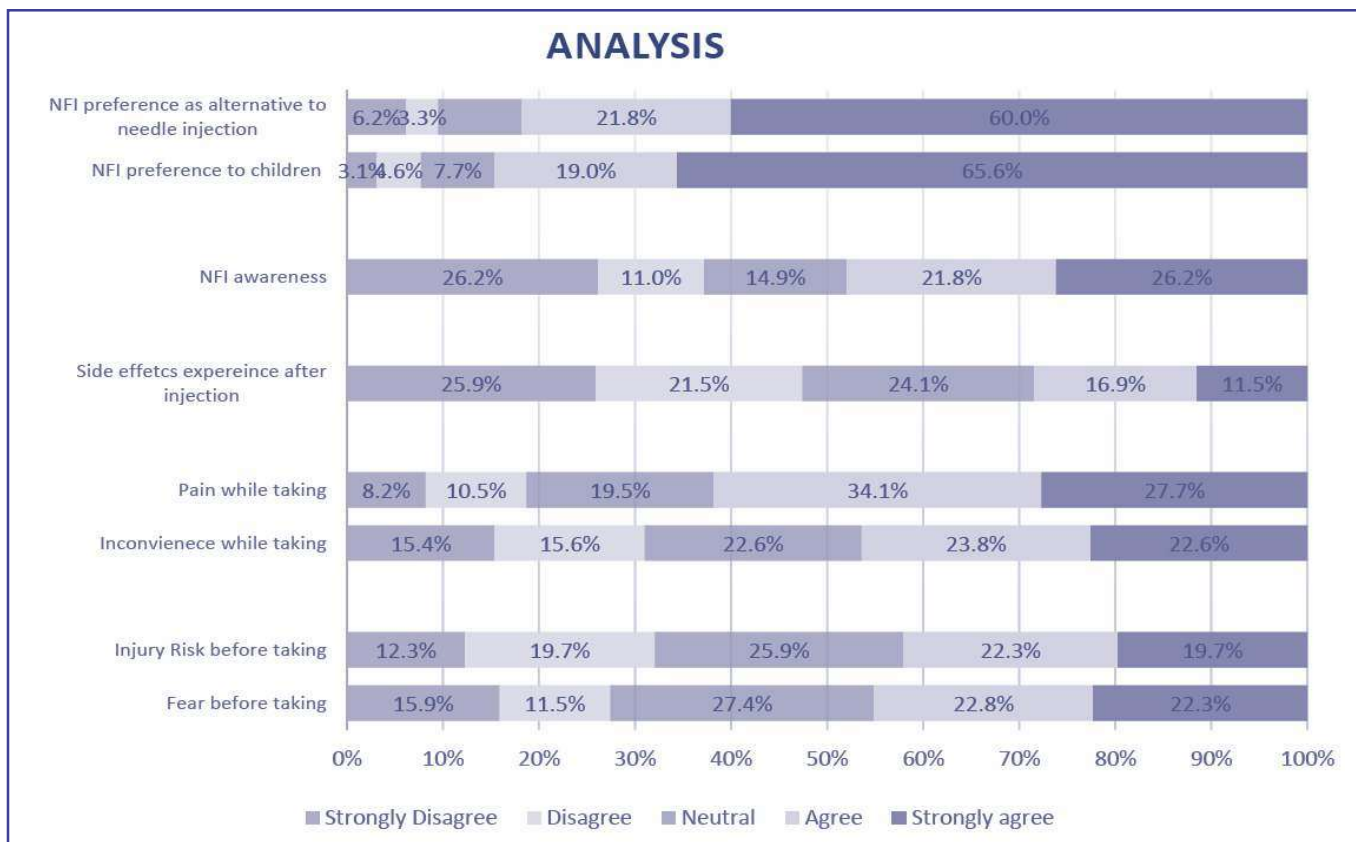


Figure 5. Various Perception and Preference Analysis.

Table 4. KMO and Bartlett's test.

<b>KMO measure of sampling adequacy</b>		0.843
Bartlett's Test Sphericity	Approx. chi-square	3081.929
	Degree of freedom	136
	Significance	.000

what need to be, thus that factor can be a concern during generalisability.

## Conclusion

The study's main objective was to understand the important factors that influence how people perceive needle free injection (NFI). Such an NFI survey may assist healthcare practitioners, nurses and other professionals incorporate needle-free injection into routine procedures and large vaccination programs. Physical and psychological factors such as pain (61.8%), inconvenience (46.4%), fear (45.1%), needle injury (42%) and various side effects (28.4%) such as redness, swelling, itching and lump together significantly contribute to the perception of alternative options for needles, such as needle free injections, to prevent such issues. In addition, only a small percentage of healthcare professionals and even fewer people with no medical background are aware of this

new pain-free method of administration, despite a high level of desire for NFI, according to the study. Survey provides insights that whether there is need of needle free injection to overcome this perception of pain with needles or not. Preference to

Table 5. Rotated component matrix.

	Components			
	1	2	3	4
Preference to NFI				
P1	0.752			
P2	0.751			
P3	0.784			
P4	0.790			
P5	0.828			
P6	0.608			
Awareness to NFI				
A1		0.867		
A2		0.899		
A3		0.891		
A4		0.860		
Fear of needle				
F1			0.894	
F2			0.824	
F3			0.710	
F4			0.691	
Risk of injury of needle				
R1				0.767
R2				0.469
R3				0.797

Table 6. Descriptive statistics.

	N	MEAN	SD	CronhBach's alpha
<b>PREFERENCE TO NFI</b>				<b>0.850</b>
P1	390	3.241	1.3485	
P2	390	3.226	1.3663	
P3	390	3.626	1.2225	
P4	390	2.697	1.4767	
P5	390	3.174	1.2948	
P6	390	3.874	1.3171	
<b>AWARENESS TO NFI</b>				<b>0.910</b>
A1	390	2.667	1.3325	
A2	390	3.108	1.5541	
A3	390	3.026	1.5919	
A4	390	3.177	1.5585	
<b>FEAR OF NEEDLE</b>				<b>0.831</b>
F1	390	2.810	1.5888	
F2	390	4.267	1.0517	
F3	390	4.254	1.0706	
F4	390	4.395	1.0206	
<b>RISK TO INJURY OF NEEDLE</b>				<b>0.639</b>
R1	390	4.300	.9619	
R2	390	4.497	.9693	
R3	390	4.262	1.1443	

NFI being another significant factor creating perception towards needle free injection such preference for all range of disease therapies, for children and self-administration are high. An overall conclusion, there is high preference and moderate awareness of needle free injection in routine healthcare practices. Study contributes to a better understanding for healthcare professional about willingness of people (81.1%) to accept NFI as alternative to hypodermic needle and understand future market of needle free injection. Children typically have more injection anxiety, thus the study also examined how willing people want to use this novel technique on them. The majority of adults (84.4%) said they would be willing to use NFI on children. In this way, individuals who avoid therapy or don't comply with it because they find it uncomfortable or difficult to get injections with needles can also receive treatment. Thus, these four physiological and behavioural factors-fear of needles, injury from needle use, awareness and preference for NFI-significantly influence perceptions of NFI. As a result, this research has important clinical significance for healthcare settings and pharmaceutical firms developing patient-centric approaches.

settings and

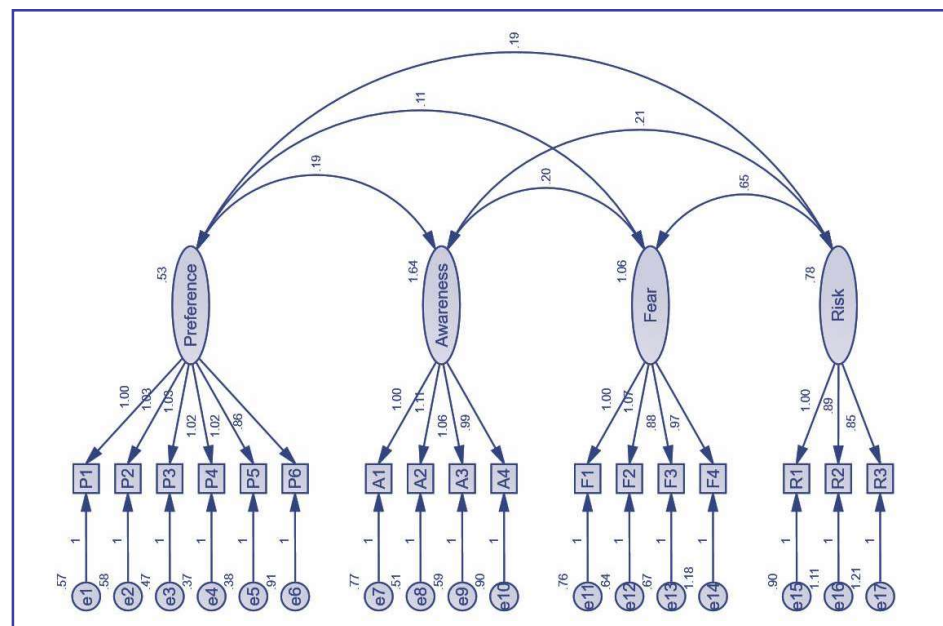


Figure 6. Confirmatory Factor Analysis Using Amos.

**Limitation and future scope**

Study is conducted for age group above 12 only. Children from age group 5-12 experience high pain and have side effects also such study has to be done from their guardian. Apart from this as per responses receive not only children but adults are also having very painful perception related needle. Swelling, blood loss, lump, redness and other are major concern of people from long ago, yet now various devices are available but due to lack of awareness in Indian

# Research Article

Table 7. Regression Weights/Factor Loading.

Variables		Factors	Estimate	S.E. (Standard Error)	C.R. (critical ratio)	P (Probability value)	Label
X7	<---	Preference	1.000				
X8	<---	Preference	1.029	.080	12.840	***	par_1
X9	<---	Preference	1.019	.080	12.750	***	par_2
Y1	<---	Preference	1.022	.078	13.130	***	par_3
Y2	<---	Preference	1.009	.075	13.395	***	par_4
Y3	<---	Preference	.857	.087	9.806	***	par_5
X3	<---	Awareness	1.000				
X4	<---	Awareness	1.111	.052	21.267	***	par_6
X5	<---	Awareness	1.057	.052	20.331	***	par_7
X6	<---	Awareness	.996	.055	18.259	***	par_8
V4	<---	Fear	1.000				
V2	<---	Fear	1.142	.084	13.542	***	par_9
V3	<---	Fear	1.220	.085	14.395	***	par_10
X2	<---	Fear	1.121	.090	12.432	***	par_11
V6	<---	Injury Risk	1.000				
V7	<---	Injury Risk	.881	.107	8.260	***	par_12
V8	<---	Injury Risk	.876	.098	8.960	***	par_13

Table 8. Estimates of Different Factors.

			Estimate	S.E. (Standard Error)	C. R. (critical ratio)	P (Probability value)	Label
Preference	<-->	Awareness	.190	.055	3.440	.000	
Preference	<-->	Fear	.114	.045	2.505	.012	
Preference	<-->	Risk	.188	.047	4.050	.000	
Awareness	<-->	Fear	.195	.077	2.528	.011	
Awareness	<-->	Risk	.214	.076	2.825	.005	
Fear	<-->	Risk	.655	.083	7.877	.000	

Table 9. Reliability and Generalisability.

Factor estimate	CR	AVE	MSV
Awareness	0.8	0.6	0.5
Preference	0.8	0.5	0.1
Fear	0.9	0.7	0.0
Injury risk	0.68	0.5	0.4
Normal criteria	0.700	0.500	<AVE

Note: CR= composite reliability, AVE is average variance extracted and MSV is Maximum shared squared variance.

demographic it has delay the use of NFI in routine in the hospital and self-administration also. A proper awareness program has to be done at Hospital and PHC to make people and healthcare professional aware about it, as it has direct impact on adherence of treatment of patient, mass immunization like program and ultimately health of patient. The cost of NFI is high hence some research needs to be done in that field again.

No specific grant was given to this research by any funding organisation in the public, private, or non-profit sectors. Research study is done by Niper-Ahmedabad.

## References

- Arora N. K. (2012). Injection practices in India. WHO South-East Asia Journal of Public Health, 1(2), 189-200.
- Alkilani, A. Z., McCrudden, M. T. C., and Donnelly, R. F. (2015). Transdermal drug delivery: Innovative pharmaceutical developments based on disruption of the barrier properties of the stratum corneum. In *Pharmaceutics* (Vol. 7, Issue 4, pp. 438-470).
- Orenius, T., LicPsych, Säilä, H., Mikola, K., and Ristolainen, L. (2018). Fear of Injections and Needle Phobia Among Children and Adolescents: An Overview of Psychological, Behavioral, and Contextual Factors. *SAGE Open Nursing*, 4. <https://doi.org/10.1177/2377960818759442>
- Adu, M. D., Malabu, U. H., Malau-Aduli, A. E. O., and Malau-Aduli, B. S. (2019). Enablers and barriers to effective diabetes self-management: A multi-national investigation. *PLoS ONE*, 14(6). <https://doi.org/10.1371/journal.pone.0217771>

## **Research Article**

5. McDonald, S., B. A. L. J., C. K. L., C.-H. A., and J. S. (2021). The prevalence and evidence-based management of needle fear in adults with chronic disease: A scoping review. *PLoS One*, 16(6).
6. Huang, et al. (2022). Electromagnetic Force-Driven Needle-Free in Ovo Injection Device. *Veterinary Sciences*, 9(3), 147.
7. Weniger, B. G., and Papania, M. J. (2012). Alternative vaccine delivery methods. In *Vaccines: Sixth Edition* (pp. 1200-1231). Elsevier Inc. <https://doi.org/10.1016/B978-1-4557-0090-5.00063-X>
8. Adepu, S. and R. S. (2021). Controlled Drug Delivery Systems: Current Status and Future Directions. *Molecules* (Basel, Switzerland), 26(19), 5905.
9. Baxter, J. and Mitragotri, S. (2006). Needle-free liquid jet injections: Mechanisms and applications. In *Expert Review of Medical Devices* (Vol. 3, Issue 5, pp. 565-574). <https://doi.org/10.1586/17434440.3.5.565>
10. Aldawood, F. K., et al. (2021). A Comprehensive Review of Microneedles: Types, Materials, Processes, Characterizations and Applications. *Polymers*, 13(16), 2815.
11. Labu, Z. K. et al. (2013) Comparative Studies of Needle Free Injection Systems and Hypodermic Needle Injection: A Global Perspective. *J. Pharm. Biol. Res.* 1, 39-49.
12. Pervaiz, M., Gilbert, R., and Ali, N. (2018). The Prevalence and Underreporting of Needlestick Injuries among Dental Healthcare Workers in Pakistan: A Systematic Review. In *International Journal of Dentistry* (Vol. 2018). Hindawi Limited. <https://doi.org/10.1155/2018/9609038>
13. Hardavella, G., Aamli-Gagnat, A., Frille, A., Saad, N., Niculescu, A., and Powell, P. (2017). Top tips to deal with challenging situations: Doctor-patient interactions. *Breathe*, 13(2), 129-135. <https://doi.org/10.1183/20734735.006616>
14. Ravi, A., Sadhna, D., Nagpaal, D., and Chawla, L. (2015). Needle free injection technology: A complete insight. *International Journal of Pharmaceutical Investigation*, 5(4), 192. <https://doi.org/10.4103/2230-973x.167662>
15. Mitragotri, S. (2005). Immunization without needles. In *Nature Reviews Immunology* (Vol. 5, Issue 12, pp. 905-916). <https://doi.org/10.1038/nri1728>
16. Alsbrooks, K., and Hoerauf, K. (2022). Prevalence, causes, impacts, and management of needle phobia: An international survey of a general adult population. *PLoS One*, 17(11), e0276814. <https://doi.org/10.1371/journal.pone.0276814>
17. Freeman D et al. (2021) Injection fears and COVID-19 vaccine hesitancy. *Psychol. Med.*, 1-11.
18. McLenon, J., and Rogers, M. A. M. (2019). The fear of needles: A systematic review and meta-analysis. In *Journal of Advanced Nursing* (75, 1, pp. 30-42). Blackwell Publishing Ltd. <https://doi.org/10.1111/jan.13818>
19. Kose, S. and Mandiracioglu, A. (2007). Fear of blood/injection in healthy and unhealthy adults admitted to a teaching hospital. *International J. Clinic. Pract.*, 61(3), 453-457.
20. Yelland, J., M., Heathcote, K. E., Kay Angus Ng, S., heathcote MPH, K., ng, shu-K., (2014). Fear of needles: Nature and prevalence in general practice Ovarian cancer biomarker research View project Episodic volunteering View project. <https://www.researchgate.net/publication/24198054>
21. Malas, O., and Tolsá, M. D. (2022). Needle-related Fear versus Vaccination Fear, Vaccination Intention, and Declared Reasons for Avoiding Vaccination. *Clínica y Salud*, 33(3), 101-107. <https://doi.org/10.5093/clysa2022a11>
22. Chaudhry, K., Shishodia, M., Singh, C., and tuli, A. (2015). Comparative evaluation of pain perception by vibrating needle (Vibraject™) and conventional syringe anesthesia during various dental procedures in pediatric patients: A short study. *International Dental & Medical Journal of Advanced Research*, 1(1), 1-5. <https://doi.org/10.15713/ins.idmjar.5>
23. McMurtry, C. M., Riddell, R. P., Taddio, A., Racine, N., Asmundson, G. J. G., Noel, M., Chambers, C. T., and Shah, V. (2015). Far from "just a poke": Common painful needle procedures and the development of needle fear. *Clinical Journal of Pain*, 31(10), S3-S11. <https://doi.org/10.1097/AJP.0000000000000272>
24. Kennedy, R. M., Luhmann, J., and Zempsky, W. T. (2008). Clinical Implications of Unmanaged Needle-Insertion Pain and Distress in Children. In *Pediatrics* (Vol. 122, Issue SUPPL. 3). <https://doi.org/10.1542/peds.2008-1055e>
25. Hair, J. F., et al. (2019). In *Multivariate Data Analysis* (8th ed.). Cengage Learning, EMEA.
26. Wali, A., et al. (2016). Evaluation of fear of injections and its association with avoidance of Dental treatment. *Journal of Restorative Dentistry*, 4(3), 81.
27. Deacon, B., and Abramowitz, J. (2006). Fear of needles and vasovagal reactions among phlebotomy patients. *Journal of Anxiety Disorders*, 20(7), 946-960. <https://doi.org/10.1016/j.janxdis.2006.01.004>
28. Nicholas, M. K. (2007). The pain self-efficacy questionnaire: Taking pain into account. *European Journal of Pain*, 11, 153-163. <https://doi.org/10.1016/j.ejpain.2005.12.008>

### **Acknowledgements**

NRK would like to express my special thanks of gratitude to Dr. Rooshabhkumar Mehta, for expert advice and encouragement throughout the research process.