*Original Article:*
## Speech Language Pathologist's Knowledge of Genetics – An Indian Perspective

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**Abstract:** Background and Objectives: The aim of the present study was to examine the knowledge, attitudes and confidence levels about genetics among speech-language pathologists (SLPs) working in India; and further to identify the relationship between knowledge, attitudes and confidence levels. Methods: A cross-sectional study design was implemented to carry out an email-based survey to assess the knowledge, attitudes and confidence levels about genetics among SLP's in India. Results: Responses from 121 SLP's working with pediatric population were analyzed. Results suggested that 70.3% of responses were correct for the genetic knowledge based questions. The confidence levels and attitudes were in the medium categories. The primary sources of learning were from school lesson as reported by the professionals. There existed a positive correlation between knowledge index and the mean attitude and confidence levels. Conclusion: The findings of the present study add valuable information to international literature and provides suggestions towards increasing more topics related genetics into the curricula.
**Key Words:** Genetic, Knowledge, Attitude, General knowledge Index, Speech Language Pathology

**Introduction:**
The discipline of Speech-language pathology is interlinked with a plethora of fields that include otorhinolaryngology, neurology and genetics among others. The knowledge of genetics helps in understanding certain aspects of disorders of speech and communication.(1) Twin and adoption studies have enabled in understanding the influence of genetics on language, reading and mathematical skill acquisition.(2,3) The knowledge of genetics and development aids in understanding of acquisition of speech, auditory skills, language and literacy. It furthers helps in the understanding typical as well as atypical development patterns. Genetics studies have enabled in explaining the intervention and diagnosis of the impairment associated with speech and language.(4)
SLP's deal with genetic disorders such as hearing loss caused by more than 50 genes and 80 additional loci. Chromosomes such as 1, 3, 6, 7, and 15 has been associated with various speech disorders (5), FOXP2 gene linked with autism spectrum disorders(6), dyslexia(7), specific language impairment(8), developmental verbal apraxia(9) and stuttering.(10)
There have been previous attempts at exploring the knowledge and attitudes towards genetics among different health care professionals across the world in the field of genetics. A systematic review of studies on knowledge of genetics among nurses included six studies and revealed an overall low level of knowledge being delivered to the nurses.(11) Lapham, Kozma, Weiss, Benkendork and Wilson (12) studied the genetic knowledge of several professionals such as occupational therapists, SLP's, psychologists, nurses, physicians and social workers. Blood and Blood (13) surveyed SLP's in Pennsylvania State using the Core competencies for the Genetic education of NCHPEG.
Tramontana et al (4) have explored the perceived confidence, attitude, knowledge acquisition and practice based concepts among school-based speech pathologists registered under American Speech Language Hearing Association (ASHA). Hwang and Ryu (1) surveyed the knowledge and attitudes of genetics among SLP's working in Korea.
*Need of the present study*
Genetics places a significant role in the development of speech and language. Also, information on genetics has an important role in the diagnosis, treatment and counselling of speech and language disorders. Attempts have been made to assess the knowledge and attitudes of SLP's towards genetics in Korea and United States. The present study aims to examine the knowledge, confidence levels and attitudes towards genetics of SLP's practising in India. The study further explores the different sources from where these professionals acquire knowledge.
**Method**
*Participants*
Four hundred practicing SLP's registered under Indian Speech and Hearing Association were emailed the survey questionnaire. The responses of SLP's practicing in India for

a minimum of one year were considered for inclusion in the study. The participation in the study was voluntary and consent was taken from the participants.

*Questionnaire*

The questionnaire developed by Tramontana et al (4) to study the knowledge, attitude and confidence of school-based SLP's regarding genetics was used for the present study. Prior permission was taken from the corresponding author. The questionnaire consisted of five-parts comprising a total of 61 items.

In the present study, part 1 comprised of questions eliciting demographic information such as age, gender, education and work experience. The part 2 comprised of 29 questions eliciting the general knowledge towards genetics. The questions were to be answered on a three- point response scale of yes, no and not sure. All the 'incorrect and unsure responses' were given a score of one while all the 'correct' answers were scored two. The total was considered as General Knowledge Index (GKI) ranged from a minimum of 29 (if all responses were incorrect and not sure) to a maximum of 58 (all responses were correct).

The part 3 and 4 consisted of questions on confidence levels and attitudes regarding genetics respectively. The rating scale for questions on confidence levels consisted of a five-point rating scale (where 1 denoted not at all confident, 2 denoted somewhat confident, 3 denoted somewhat unsure, 4 denoted somewhat confident and 5 denoted confident). The rating for questions on attitude towards genetics consisted of a five-point rating; 1 for strongly disagree while 5 denoted strongly agree. Part 5 of the questionnaire required the SLP's to denote the sources from where they might have acquired knowledge regarding genetics. The professionals could mark multiple choices from a list of ten items. The ten categories included formal coursework (graduation and post-graduation), conferences and seminars, magazines and newspapers, web-based courses, internet surfing, self-study, practical experiences and others. The professionals were provided with the option to key-in other sources of information if not included in the list.

*Procedure*

A questionnaire form was created using Google documents and was e-mailed to 400 registered SLP's under the Indian speech and hearing association randomly. Only those SLP's who had a completed their master's program were only considered. This was to ensure an equal academic qualification across all the participants. A cover letter explaining the purpose of the study was also attached. The form was made in such a way attempting all the questions was must for submitting the response, to avoid incomplete forms. A follow-up reminder was sent 20 days after the initial e-mail.

*Data Analysis*

Descriptive statistics was used to summarize demographic information, general knowledge, GKI, confidence levels, attitude scores and sources of knowledge. Cronbach's alpha was used to check the reliability of the sub-scales on general knowledge, confidence levels and attitude scores. Pearson product moment correlation was used to determine the relationship between GKI and confidence and attitude scores. All statistics were performed using SPSS version 15 (SPSS, Inc., South Asian Ed, Bangalore, India).

**Results**

*Demographic information of participants*

Four hundred professionals were e-mailed of which 121 responded (response rate of 30.25%). A majority of the respondents were females 69.4% (n = 84) while the remaining 30.6% were males (n= 37). About 86% of the participants were below 40 years of age while 14% were above 40 years of age.

*Reliability analysis*

Cronbach's alpha was used for reliability analysis for the sub-scales on general knowledge, attitude and confidence levels.

The Table 1 shows the values obtained for Cronbach's alpha for the sections on general knowledge, attitudes and confidence levels for the present study as well as for the previous studies on SLP's in US and Korea.

| Table 1: Internal consistency reliability in the present and previous studies | | | |
|---|---|---|---|
| | GKI | Confidence levels | Attitudes |
| Present study | 0.73 | 0.83 | 0.88 |
| Tramontana, Blood, & Blood [4] | 0.74 to 0.91 | 0.88 | 0.84 |
| Hwang and Ryu [1] | 0.91 | 0.93 | 0.86 |

*General knowledge*

The responses given by the professionals for the general knowledge questions have been given in Table 2.

| Table 2: Responses to 29-item General knowledge scale | | | |
|---|---|---|---|
| Question | Correct Response | Incorrect Response | Not sure |
| Your blood can uniquely identify you because it contains your DNA. (True) | 79 (65.3%) | 32 (26.4%) | 10 (8.3%) |
| One can see a gene with the naked eye. (False) | 116 (95.9%) | 0 | 5 (4.1%) |
| Healthy parents can have a child with a hereditary disease. (True) | 108 (89.3%) | 6 (5%) | 7 (5.8%) |
| Eye color is entirely determined by a person's genes. (True) | 80 (66.1%) | 25 (20.7%) | 16 (13.2%) |
| If close relatives have diabetes/heart disease, you are more likely to develop these diseases. (True) | 85 (70.2%) | 27 (22.3%) | 9 (7.4%) |
| All serious diseases are hereditary. (False) | 98 (81%) | 2 (1.7%) | 21 (17.4%) |
| Genes control the characteristics we inherit from our parents. (True) | 105 (86.8%) | 2 (1.7%) | 14 (11.6%) |
| A gene is a disease. (False) | 119 (98.3%) | 2 (1.7%) | 0 |
| The carrier of a disease gene may be completely healthy. (True) | 91 (75.2%) | 20 (16.5%) | 10 (8.3%) |
| The onset of certain diseases is due to genes, environment and lifestyle. (True) | 95 (78.5%) | 16 (13.2%) | 10 (8.3%) |
| If a person is the carrier of a disease gene it means that they have the disease. (False) | 92 (76%) | 6 (5%) | 23 (19%) |
| It is the father's chromosomes that decide if a baby is a boy or a girl. (True) | 103 (85.1%) | 18 (14.9%) | 0 |
| The child of a disease gene carrier is always also a carrier of the same disease gene. (True) | 34 (28.1%) | 42 (34.7%) | 45 (37.2%) |
| Living a healthy lifestyle will not make any difference if you have an increased genetic risk for a disease. (False) | 61 (50.4%) | 38 (31.4%) | 22 (18.25%) |
| Having increased genetic risk means you get that disease regardless of what you do. (False) | 48 (39.7%) | 43 (35.5%) | 30 (24.8%) |
| Genes are bigger than chromosomes. (False) | 87 (71.9%) | 13 (10.7%) | 21 (17.4%) |
| A gene is a cell. (False) | 94 (77.7%) | 19 (15.7%) | 8 (6.6%) |
| Half your genes come from your mother and half from your father. (True) | 94 (77.7%) | 21 (17.4%) | 6 (5%) |
| Your blood contains a full copy of all your genes. (True) | 77 (63.6%) | 28 (23.1%) | 16 (13.2%) |
| A gene is a piece of DNA. (True) | 79 (65.3%) | 38 (31.4%) | 4 (3.3%) |
| Different body parts include different genes. (False) | 85 (70.2%) | 18 (14.9%) | 18 (14.9%) |

| | | | |
|---|---|---|---|
| A gene is a molecule that controls hereditary characteristics. (True) | 102 (84.3%) | 10 (8.3%) | 9 (7.4%) |
| Genetic diseases can be categorized into three major groups: single-gene, chromosomal, and multifactorial. (True) | 83 (68.6%) | 6 (5%) | 32 (26.4%) |
| The genotype is not susceptible to human intervention. (True) | 22 (18.2%) | 58 (47.9%) | 41 (33.9%) |
| An allele is an alternative form of a gene (one member of a pair) that is located at a specific position on a specific chromosome. (True) | 86 (71.1%) | 9 (7.4%) | 26 (21.6%) |
| Genes are inside cells. (True) | 90 (74.4%) | 17 (14%) | 14 (11.6%) |
| A gene is a part of a chromosome. (True) | 103 (85.1%) | 18 (14.9%) | 0 |
| DNA is made up of four nitrogen bases called nucleotides including: adenine (A), guanine (G), cytosine (C), and thymine (T). (True) | 113 (93.4%) | 0 | 8 (6.6%) |
| It has been estimated that a person has about 22,000 genes. (True) | 38 (31.4%) | 1.9 (15.7%) | 64 (52.9%) |
| **Total responses** | 2,467 (70.3%) | 553 (15.76%) | 489 (13.94%) |

Of the total of 3509 responses (121particpants * 29 questions), 70.3% (n = 2467) were correct, 15.76% (n = 553) were incorrect and 13.94% (n = 489) were unsure.

General Knowledge Index (GKI) was calculated by adding all the responses, after coding the correct responses as 2 and incorrect as well as not sure responses as 1. The mean GKI obtained was 49.41 (SD= 4.10) and the minimum- maximum scores obtained were 39 and 57 respectively.

The mean score for the confidence levels was 22.26 (SD= 4.91) with a range from 8 to 30. The mean score for the attitude was 20.56 (SD = 4.70) with a range from 5 to 25. Pearson product moment correlation was used to determine the relationship between GKI and attitude and confidence levels. The GKI positively correlated with attitudes ($r = 0.234$, $p = 0.010$) as well as confidence levels ($r = 0.378$, $p <0.001$), both of these correlations were significant at 0.01 level.

The majority of participants (41%) reported that they learnt about genetics at school, followed by graduate classes (35%). The distribution of responses for the remaining sources of learning was as follows; postgraduate classes (20%), web-based (14%), journals (12%), magazines (6%), practical experience (5%0 and seminars (4%).

**Discussion**

The present study sheds light on certain important aspects such as general knowledge, attitudes and confidence levels regarding genetics among SLP's. The knowledge regarding genetics forms an important aspect of the clinical services offered by a SLP particularly in the diagnosis, treatment and counselling. If the professional is well equipped with the knowledge, it can be used while teaching students and counselling parents and caregivers.

The questionnaire consisted of general questions on genetics and did not focus on any specific genetic condition. Out of the 29 questions on general knowledge, SLP's responded correctly for almost 25 (86.2%) questions (>50%). In the study by Tramontana et al. 4, school based SLP's responded correctly (>50%) for about 20 items. The GKI obtained was 19.2. In another study on SLP's in Korea, the mean GKI score was 16.19 (range 6 to 28). While in the present study, the mean GKI score obtained was 49.41 (range 39 to 57) which was comparatively higher than the previous studies. The variation in the scores could be the result of differences in the syllabus across the countries. Also, only those SLP's who were interested in participating filled the questionnaire, which could be one of the reasons for high scores. The majority of the professionals (41%) had responded that they learnt about genetics from their school classes. Therefore, in spite of

comparatively better scores as compared to previous studies, there is a need to bring about changes in the curriculum. Especially, there is a need to update the existing curriculum to include more updated research findings. Online modules, e-learning and seminars can be made available which can help in addressing a large number of professionals.

The knowledge of a professional towards genetics has influence on their confidence in the subject. Christianson, McWalter, & Warren (14) have suggested that lack of appropriate information and gaps in knowledge regarding genetics could have a negative impact on the professional's ability to work confidently. They have further reported that lack of appropriate syllabus and curriculum has an impact on the clinical application. Lapham et al (12) have reported that most of their participants discussed genetic related topics while dealing with clients. However, only 17% demonstrated high confidence levels. Tramontana, Blood & Blood (4) in their study on SLP's suggested that most SLP's were unsure about their confidence regarding genetic related topics with a mean score of 16.7 (S.D.= 5.5). The mean score obtained by SLP's from Korea was 18 (S.D. = 5.96) for the confidence levels. (1) In both these studies, an overall poor level of confidence had been reported. In the present study, a comparatively highly confidence level with a mean of 22.26 (S.D. = 4.91) was found. This could be the resultant of an overall higher GKI score among this population, which could have lead to better confidence levels. A low positive correlation was found between GKI and confidence levels, therefore, as the knowledge increases, there is an overall increase in the confidence levels.

Khoury et al (15) have attributed a major role to attitude and confidence levels of an individual to be able to communicate effectively with clients, their families and caregivers. In the present study, for the questions assessing the attitudes, a mean of 20.56 (S.D.= 4.7) was obtained. This was comparatively higher than the previous studies; Tramontana et al (2013) reported a mean score of 13.6 (S.D 4.7) on the questions assessing the attitudes towards genetics while Hwang and Ryu (1) reported a mean of 9.56 (S.D. = 3.51). A low but positive correlation was found between GKI and attitude levels, suggestive that an increase in knowledge would lead to an improvement in the attitude.

Lessons learnt at school, graduate and post graduate classes were among the most commonly mentioned sources of learning for the SLP's in the present study. The majority of SLP's in the USA had reported self-study via the web and internet based searches, on the job training and popular press magazines and newspapers as the three primary sources of knowledge about genetics. It was interesting to note the contrasting differences in the sources of learning. However, in both the studies, a low percentage of SLP's relied on scientific literature such as journals and seminars to gain information. This could have an impact on the nature and kind of information being received and therefore requires some changes to be implemented.

**Conclusion**

Even though the professionals might be lacking the required knowledge in the field of genetics, they were aware of the relevance of genetics. This lack of adequate knowledge indirectly influences their attitudes and confidence levels; which could impact their clinical skills. The present study contributes to the international literature regarding the value of increasing the curricula related to genetics. It also sheds light on to the need for more clinical applications and avenues for SLP's to work with pediatric population either as collaborative practice teams or as independent practitioners.

The findings of the present study are in tune with those reported on SLP's from other geographic locations. Most of the professionals reported that they learnt about genetics at school, this warrants the need to provide changes in the

professional studies curriculum and provide more sources of learning to update their knowledge in genetics. There are several opportunities for additional research in the area of genetics that is clinically related to speech and hearing related disorders.

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