

Developing adolescent health-risk behavior instrument using Delphi method

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ABSTRACT

Background: There are a number of challenges in developing a reliable and valid instrument on health risk behaviour of adolescents because adolescents are reluctant to disclose negative health behaviour. This research used the Delphi method, supplemented by literature review and grounded theory, to understand health risk behaviour and its determinants. **Method:** Qualitative questionnaires were sent to experts in round I. In round II, an online questionnaire with major determinants in five point Likert scale was sent to experts. In round III, a group of experts met, revised and developed consensus on adolescents' health risk behaviour and their major determinants. **Results:** Round I identified 117 major determinants. Altogether, 86 determinants were selected from round I. In round II, this was reduced to 52 determinants with more than 70 percent consensus. Altogether 12 determinants, which scored more than 50 percent that were supported by literature and grounded theory, were added after consensus development with experts in round III. **Conclusion:** Low response rate, identification and selection of experts, experts' time constraints were major methodological challenges whereas logistic management and time consuming nature of the method were major non-methodological challenges in the Delphi process. These challenges, however, can be overcome or minimized.

Key words: Behavior, challenges, Delphi, determinants, health risk

INTRODUCTION

Human behavior is one of the important factors that lead to ill-health condition and disease. A risk behavior is defined as a lifestyle activity that places a person at increased risk of suffering, illness, or injury. Behaviors that result in negative health outcomes are considered as health-risk behavior (HRB). HRB of individuals may be related to a person's social, cultural, religious, moral, and legal aspects, so it is difficult to generalize HRB across the culture.^[1] HRB in adolescents has been considered as one of the important public health issues because it shapes adult behavior and the consequences are costly for society.^[2] HRB in adolescents may be due to cognitive process such as brain development stages or due to biological process such as hormonal changes in a transition period from childhood to adulthood.^[3]

The major HRBs among adolescents are substance (cigarette, alcohol, and drug) abuse and unsafe sex, all of which may lead to seriously impaired lives and even premature deaths.^[4]

The US Department of Health and Human Service Report (2016) showed that 9 out of 10 smokers started smoking at the age of 18 and 99% started at the age of 26, so it is important to correct the behavior among young people.

Risk-taking behavior varies in between adolescents and adults. Adolescents have greater willingness to accept the situation in which the likelihood of winning or losing is unknown and they have higher tolerance for unknown when compared with adult.^[5]

Moreover, the perception of adolescents' risk taking by adult and adolescents themselves is different as many adults consider adolescents' risk taking as gaining a taste of life and necessary to life, whereas adolescents consider their own risk taking as an adventure and thrill.^[6]

There are many challenges for investigating HRBs; how to validly and reliably measure and analyze risk behavior are two important aspects in research related to HRB. The measurement challenge begins from the process of instrument development. Guidelines in the instrument development literature are variable, but thirteen major steps conducted in planning, construction, qualitative evaluation, and validation phase may provide a roadmap in the field of occupational therapy. State purpose of test and target groups, review literature on construct or variable of interest, writing objectives and selecting items format, write pool items, content validation, develop new or revise items, prepare instrument for first pilot testing, run item analysis, revise and second pilot testing, second pilot administration, repeat Step 9-10, begin validation, and continue validation are 13 major steps in instrument development.^[7]

Most adolescent HRBs are usually measured by self-administered questionnaire, and the adolescents answer retrospectively. There are a number of challenges in recalling the HRB. Some risk behaviors are very sensitive that respondents do not want to report them because they believe that engaging in such behaviors is socially undesirable.^[8] In many instances, adolescents underreport or overreport deliberately. For example, in a smoking

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behavior-related survey, adolescents may underreport the incidence of smoking because they want to hide it from parents or teachers, but on the other hand, they may over report it in peer-led interview to show their womanhood. On the other hand, asking questions to adolescents on risk behavior itself is risky undertaking because if the adolescent who hold positive or ambiguous attitude toward that particular behavior will lead to an increase in the performance of that particular behavior and individual with such questions behavior effects can be protected by altering question target, time orientation, or wording or by providing warning about the impact of questions.^[9] Hence, asking questions to adolescents about risky behavior have potential to increase that particular behaviors which are sometimes counterproductive for adolescents.

Different methods have been used by different researchers for developing valid and reliable instrument in adolescents' HRB survey. The Delphi method is one of the methods proven to be an excellent tool in establishing face and content validity of such instruments. In the past, Delphi techniques have been overlooked due to its labor-intensive nature, but now in many educational and health research, it is considered as an effective and efficient research tool.^[10] In the Delphi method, evidence for content and face validity of the instrument are due to three major characteristics: First, the results are due to group opinion which is more valid than single person decision; second, the process is based on expert opinion in each iteration from local context, and finally, the first open qualitative round allows to item generation, and successive rounds allow review and judgment as to the appropriateness of generated items.^[11]

The purpose of this paper is to highlight the results of a process to develop an instrument for measuring adolescents' HRB and identifying major determinants using the Delphi method complemented by literature review and grounded theory. Furthermore, the paper will reiterate the Delphi process for establishing face and content validity of measurement instrument. The paper will also discuss both methodological and non-methodological challenges in the instrument development process.

METHODS

Method and methodology include study design, Delphi participants, consensus development process, and detail of Delphi process.

Study Design

The instrument development process in the study involved the Delphi process supplemented by literature review and grounded theory. The Delphi process is considered as time-consuming process due to the time required for data collection. In general, it requires 2-5 months for data collection, but it can be varied based on data collection methods such as paper-based postal or email-based online form.^[12]

Literature review is used in the initial identification of dimensions and items in most quantitative research. Sometimes, variables and items generated only through literature review might not be suitable to local context. Hence, in this process, grounded theory was also used to overcome the challenges due to stand alone use

of Delphi process or literature review for the identification of HRB and major determinants. As part of a grounded theory component, in-depth interview of students in the higher secondary school was carried out to understand the local context on the HRB where students were probed to answer open-ended questions. Ten students from two different schools were interviewed in depth during a visit to higher secondary school in Kathmandu and Lalitpur municipality. The interview with students started with open-ended questions such as what were the major risk behaviors of adolescents? What are the major factors that accelerate or reduce risk behaviors in adolescents? The interviews ranged from 45 to 90 min duration. Interviews were recorded with prior permission from students. The recordings were listened to several times by the author, and major points related to risk behavior and issues were noted. Later on, major HRB and determinants were quantified, compared, and merged to experts responses of Delphi round II.

The Delphi technique helped to estimate the face and content validity of the instrument. The Delphi method is one of the most used methods in health research design using several communication rounds to get subject matter experts' view and consensus on the content.^[13] During the Delphi process, anonymity is maintained to provide an equal chance for each expert to express views and ideas unbiased by the identities of other experts in the first two rounds. In the third round, these experts meet and establish consensus.^[14] Although anonymity could theoretically lead to a lack of accountability because responses may not traced back to individual expert,^[15] experts were not only blinded to the investigator in this study but also are only requested to keep confidentiality among group experts.

The Delphi method can overcome the drawback of domination of expert focus group discussion and conference by one or two experts if Delphi rounds are not conducted face-to-face (i.e. by correspondence). There is no universal guidelines for Delphi method, but classical Delphi method is still common in health research, sometimes refined by replacing the postal round with email or online form to speed up the response from experts. However, poor internet services in the developing world would make this refinement not as fruitful as expected. The classical Delphi method is characterized by anonymity, iteration, controlled feedback, statistical group response, and stability in response among expertise on a specific issue.^[16] It is often used to reach consensus among experts on the content and quality of measurement instruments.

Participants, Panelist, or Experts

The person with informed knowledge in the subject area or specialists is considered as an expert in Delphi round.^[17] A good selection strategy should be followed in the selection of experts, and experts can be identified on the basis of their competency based on knowledge and experience to generate and evaluate themes in the area of analysis.^[18] The major eligibility criteria for selection of participants are experience, knowledge, and interest in the area of study, ability to contribute, and ability to review initial opinions to achieve a group consensus.^[19] Therefore, experts are generally selected on the basis of subject area knowledge and experience, capacity and knowledge to participate, time available to participate, and effective communication skills; however, experts with all of those qualities may not be able to fully participate voluntarily in all round of Delphi process due to their busy schedule.^[20] In one

study, selection procedure for experts was five steps process.^[21] Step I involved identification of relevant discipline and skills, Step II involved preparing the list of experts in each discipline or skill, organization, and academic practice. In Step III, experts were nominated based on list, and nominated experts were further asked to nominate other experts, Step IV involved the process to rank experts in each discipline and skills, and Step V involved inviting experts to participate. The overall result and validity of the developed instrument revolve round the experts' views and consensus, so the expert selection process is crucial process in Delphi. In one of the studies for development and content validation of instrument to assess the nursing care product, expert panel composed of 15 nurses who had at least 10 years of professional experience, acted as teachers, preferably as leaders of research groups in management area, certified by the Scientific and Technological Development Council and nurse managers from hospital.^[22]

Experts' selection was done in four major steps in this study. The first step is the identification of institution and organization level factors related to adolescents' issues. Identification of experts within organizations who have been working with or for adolescents using telephone inquiry was done in the second step. In the third step, identified experts were asked for participation, and after their agreement to participate, they were requested to nominate other experts whom they felt worthy. Finally, grouping experts for ensuring balance participation of experts in all related areas were done. The major institutions working for or with adolescents such as non-government organization, bilateral organization, health institution, and higher secondary schools were selected.

Identified experts were contacted first by phone. A preliminary phone call or personal contact to all prospective experts before sending email may be a better choice in the Delphi process to increase response rate.^[23] The phone call informed the identified experts in brief about the context and objectives of the study. They were asked for voluntary participation. After getting preliminary approval for participation, explicit cover letter, open-ended questions on HRB of adolescents along with extensive detail instructions, and demographic sheet were sent to them through email in round I of Delphi method.

Consensus Achievement among Experts

Delphi process occurs in rounds which allows individual to change their opinions. It also allows expert to observe group response and indicating to each expert to observe their own response in Delphi.

It allows to express judgment using summary measures of the full group response, giving more response than just a consensus statement, but in final round, Delphi panelist compares own view with group's view, sometimes group score may influence panelists, and they may change their view basis of group opinion rather than their own judgment.

Delphi Process

Figure 1 showed three round of Delphi process. Identified HRB and determinants in Delphi round II were supplemented by few more items from the literature review and grounded theory.

Round I

Four subjective questions related to major HRB among adolescents were sent to 50 identified experts in different organizations through email along with cover letter, invitation, and instruction letter. The experts were mostly national and local. Their contact details were obtained from contacted respective organizations using telephone directory. After their approval to participate in telephone, questionnaire with further details was sent. The experts were from three different types of organizations as shown in Table 1.

In round I, 50 experts were identified with male-to-female ratio of 1:1. Some experts were also identified by notifying experts endorsement. The response rate of such previously notifying experts by endorsed experts was high.

The four major questions asked to experts were as follows:

1. Adolescents' health is one of our major concerns in Nepal. Would you please mention some of major health problems of higher secondary school students (Grade 11 and 12)?

Table 1: Experts invited from different organizations to participate in round I

Types of organization	Percentage of expert (n=50)	Types of participants
Non-governmental organization	60	Program managers/officers, youth coordinators, behavior change officer, research officers
Higher secondary school	30	Principals, teachers
Hospital/Health institution	10	Psychologist, physicians

n=Number of experts invited to participate in round I of Delphi

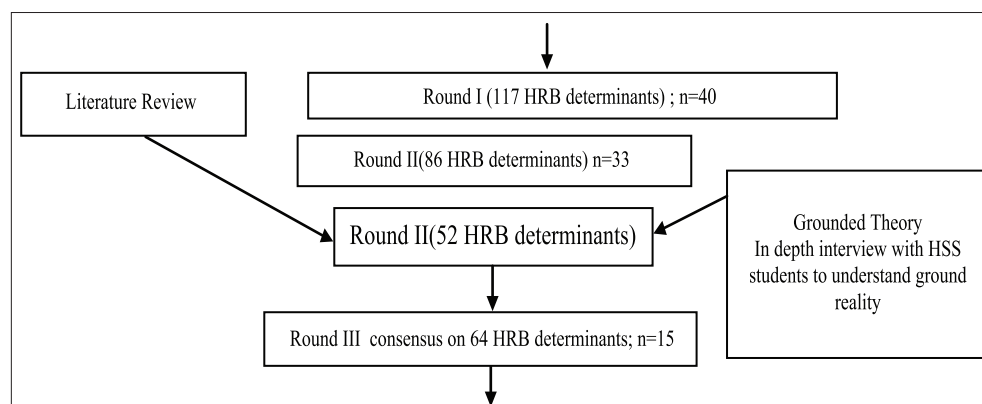


Figure 1: Delphi process supplemented by literature review and grounded theory

2. What are the major HRBs among adolescents to cause major health problems in urban areas?
3. What are the major determinants of HRB of adolescents in urban areas? Request you to elaborate your answer in personal, family, school, community/neighborhood, and societal level,
4. How can we reduce major HRBs among adolescents?

Open-ended question in the first round of Delphi study reduces the chances of excluding items or issues that the researcher may have omitted.^[24] First, unstructured questionnaire provides experts for an open response and allows relatively free scope to elaborate on the topic under investigation, and it increases the richness of data.^[25] Number of experts is often decreases in subsequent rounds, and dealing with the non-response rate is important to maintain a number of experts in Delphi process.^[26] To increase the response rate, the experts were requested to answer within 15 days, and follow-ups were done twice. The first follow-up was done within 10 days by telephone call, and the second follow-up was done both by telephone and by email after 13 days of the request.

Round II

An online questionnaire was developed in Google form on the basis of major issues identified in round I. Altogether, 86 HRB and determinants were listed, and experts or panel members were asked to rate each of item on a 5-point Likert scale (from strongly agree, agree, neutral, disagree, and strongly disagree). Altogether, 40 responded of the round I were requested to participate in round II, but only 34 respondents were responded. The response rate was high in round II than round I, and it might be due to less time-consuming online questionnaire. The responses were compiled automatically in Google spreadsheet. Items that reached >70% consensus (i.e. agreement or strong agreement) were selected for round III. About 15-day time was given for responding. Two reminders were sent in email in 10th and 14th days of the request. The response rate was high in this online version because many responded were non-governmental organizations where internet facilities were easily available.

Round III

In one of the studies conducted for developing measure of provider adherence to improve the implementation of behavioral health services in primary care Delphi process, few new items were added, eliminated, and a high level of consensus was achieved in remaining items among the group of experts.^[27] Altogether, 33 experts who responded in round II were invited for panel discussion through email. Only 15 experts participated in the panel discussion and provided their views and consensus on final process. All 52 HRB and major determinants with more than 70% score consensus from round II were selected for questionnaire development. Furthermore, HRB determinants with more than 50% score in round II, supported by literature review and grounded theory, were presented, and 12 such HRB determinants were also included for questionnaire development after endorsement by expert in round III. Therefore, 64 HRB determinants were identified for questionnaire development (Table 2). More than 50% of total items were identified by experts with more than 70% score in Delphi, 31% items were identified by Delphi with more than 50% score but supplemented by literature and grounded theory, and 19% items were from literatures and

Table 2: Result from round III of Delphi process along with 12 HRB determinants from literature and grounded theory process

Description	Number of determinants (%)
Number of HRB determinants which scored more than 70% (items from Delphi)	32 (50)
Number of HRB determinants which scored more than 50% and supported by literature and field study (items from Delphi, literature, and grounded theory)	20 (31)
Number of items from literature review and grounded theory (item from literature and grounded theory)	12 (19)
Total item considered for tool construction	64 (100)

HRB: Health risk behavior

grounded theory which all were further verified in Delphi round III by experts.

RESULTS

Results include the outcomes of Delphi process, literature search, and grounded theorization process.

Delphi Process

The overall response rate was 80% in round I. Experts identified altogether 117 issues related adolescents' health problems, adolescents' HRBs, and major issues at a different level or domain which affects adolescents' risk behavior (Table 3). Issues at different levels were identified on the basis of ecological system theory.

The major issues identified by experts were also very similar to the findings from the literature review and adolescents' opinion on grounded theory process. The response rate was 85% in round II. Altogether, 86 HRB and major determinants were identified in round II of Delphi (Table 4).

In round II, drug abuse, smoking, unsafe sex, alcoholism, and premarital sex were the major risk behavior among adolescents, each more than 90%. Out of 86 HRB determinants in round II, 52 HRB determinants scored >70% (Table 5).

Round III

The response rate was 45% in round III. With the help of 64 HRB, determinants after consensus development from experts in round III were used in questionnaire development.

Literature Review

The literature review was carried out with search terms "adolescents," "risk," "behavior," "determinants," and "factors" in Google scholar and PubMed. More than 40 articles were reviewed in the process. The major identified HRB determinants from the literature were very similar to experts' views, but HRB determinants in the family domain (such as the role of parents) were different among different cultures around the world.

Grounded Theory

Adolescents pointed out that smoking is the major HRB among adolescents, in addition to alcoholism, drug abuse, sexual

Table 3: Adolescents' health problems, risk behaviors, and health issues identified by Delphi round I experts

Dimension	Frequency	Major issues (n=40)
Adolescents' health problem	15	Stress, anxiety, tension, headache, unwanted pregnancy, sexually transmitted infections, HIV/AIDS, unsafe abortion, road accidents, poor sanitation and hygiene
Adolescents risk behavior	14	Smoking, chewing tobacco, alcoholism, drug abuse, unsafe sexual activities, multiple sex partner
Adolescents' health issues identified by Delphi round I experts		
Personal level	15	Gender, curiosity, current living, age, curiosity, educational attainment, educational level, future educational plan, religion, caste, culture, personal identity
Household level	12	Parental communication, parental monitoring, parental relationship, parental income level, family norms value, types of family, parental occupation, parental marital status, violence in family, number of siblings in family, family member involvement in risk behavior
Community level		
School	17	School curriculum, relationship with teacher, teacher's behavior, engagement in extracurricular activities, school rules/norms, teaching-learning methods, classmates, behave, school monitoring system, school and classroom environment, bullying, and victimization
Peer	6	Peer pressure, peer involvement in risk behavior, peer group affiliation, friends' behavior, gang and crowd behavior
Societal level	19	Internet, media, television, radio, access to health clinic, skills and behavior of service provider, societal norms, government rules, mobile phone, films, fashion, relationship with neighbor, youth-friendly service centers, recreation facility
Risk behavior reduction strategy	19	Parental coaching, sexuality education, counseling service, awareness program, peer group education, state law and order, engage adolescents in extracurricular activities, reduce media influence, appropriate school environment

n=Number of experts responded in Delphi round I

Table 4: Items identified from round II of Delphi process

Variables	Number of HRB determinants
Health risk behavior of adolescents	17
Demographic determinants	14
Family level determinants	14
School level determinants	24
Community-level determinants	17
Total number of item for round II	86

HRB: Health risk behavior

activities, and fighting. During field interview, students mentioned that almost 50 percent of their classmates' smoke. They believed caste, gender, chosen subject stream, health education, peer pressure, parental care, family type, media, internet facilities, and gadgets possession determined the HRB of the adolescents. They also emphasized that students from science faculty got less time to engage in risk behavior than students from management and humanities background.

DISCUSSION

The face and content validity of the variables and items were established through literature review, grounded theory, and Delphi process. The Delphi process helped to find HRB and determinants based on group consensus rather than a single viewpoint. The major risk behaviors, dimensions, and corresponding determinants were identified through expert consensus in three rounds of Delphi process, with further validation through literature review and grounded theory. One

Delphi study conducted to find the most important outcomes for effectiveness studies on migraine treatment used the flexible approach as in this study to collect data using series of questionnaires.^[28] The initial questionnaire collected qualitative information through open-ended questions,^[32] which reported back to participants through a second quantitative round, and finally, the responses in the second round were summarized and reported to participants in the third round.^[29] In general, consensus is achieved when a predefined percentage of experts come to an agreement on issues being studied.^[30] The consensus among experience experts from different institutions helped to validate the content of the instrument. Anonymity among the panelist is also a very important aspect in the validation of the instrument because usually junior panelists are reluctant to express opinions that are opposite to their seniors.^[31] Moreover, the homogeneity of the sample is a crucial step in Delphi process, and process provides opportunity for selected experts to express opinion freely by eliminating personal conflict. The experts indicated smoking, alcoholism, drug abuse, and unsafe sexual activities in round I of Delphi process as a major HRB among adolescents (Table 6) which were further validated in round II and round III. The high response rate in round II was most likely due to the easy online objective nature of questionnaire.

The major reduction in content was made in round II where 52 determinants scored more than 70%, and determinants scored more than 50% along with strongly supported by literature review and grounded theory were retained (Table 2). Hence, of 86 items, only 52 items retained.

12 HRB determinants which are not identified by experts in round I and round II but emphasized in literature and grounded theory were added for consensus development in round III. The questions

Table 5: Items related to determinants of risk behavior with more than 70% score

Level	Percentage	Level	Percentage
Personal age	80.7	Education by visiting experts	84.4
Gender	74.2	Classmate behavior	81.3
Occupation	74.2	School monitoring	81.3
Self-perception	74.2	Bullying	78.2
Curiosity	74.2	Awareness programs	78.1
Heroicness	71.9	Teacher’s behavior	71.9
Date violence	71.9	Peer	
Family		Peer pressure	96.9
Parental communication	96.9	Close involvement in risk behavior	96.9
Parental monitoring	92.6	Peer involvement with CSW	90.6
Parental Income	88	Affiliation with youth gang	87.5
Family violence	87.5	Affiliation with youth group	81.2
Relationship with parents	84.4	Community/society	
Parents on risk behavior	81.3	Attendance in night club and pub	90.6
Mother’s educational level	75.1	Prone site visit	90.6
Pocket money for adolescents	75.1	Gadget possession(mobile)	78.1
Parents marital status	75	Youth-friendly health service	78.1
		Service provider skills	71.9

CSW: Commercial sex worker

Table 6: Experts view on risk behavior of adolescents in round II

Risk behavior	Expert view in percentage (n=34)
Drug abuse	96.9
Smoking	93.8
Unsafe sex	93.7
Alcoholism	90.7
Premarital sex	90.6
Multiple sex partner	87.1
Sex with CSW	84.4
Chewing tobacco	84.4
Sex without contraception	81.3
No casual sex partner	81.3

n=Number of experts responded in Delphi round I. CSW: Commercial sex worker

on the basis of identified determinants were prepared. Some of the important demographic items were also added, so altogether, questionnaire with 127 questions was developed (Table 7).

Some studies iterated a number of methodological issues such as quality and size of panel expertise, number of rounds, questionnaire development, analysis, and achievement of consensus arises in Delphi process which have the capacity to threaten the credibility and validity of the study. Six techniques to minimize and to eliminate the biases such as collective unconscious, contrast effect, neglect of probability, von Restorff effect, myside bias, recency effect, primacy effect, and dominance, and such major bias can be reduced by randomization of questions in survey, requiring individual probability and severity ratings including reasons in controlled feedback, conducting multiple rounds of surveys, identifying individuals that have experienced recent, relevant events, and reporting results as medians rather than means.^[31]

Face validity (an assessment that a measurement instrument appears to measure what it is expected to measure) was ascertained by an overall judgment of tool for assessing the risk

Table 7: Number of questions in each domain in an instrument

Section	Major domain	Number of questions
A	Background information	18
B	Health behavior of adolescents	42
C	Family domain	18
D	School domain	23
E	Community domain	17
F	Coping mechanism for reducing risk behavior	9
	Total	127

behavior and its determinants by experts. Items in the tools were also compatible with other previously developed international tools such as IOWA Youth Survey tool 2014 (University of IOWA, 2015), Middle School Youth Risk Behavior Survey (North Dakota Department of Public Instruction, 2015), and Youth Risk Behavior Surveillance system (CDC, 2016) ranking of participants’ responses in different iterations helped to select the high scored items to establish content validity. High level of agreement in the literature review, expert opinion, and field survey indicates that finding has a high degree of generalizability.^[30,31]

Challenges in the Delphi Process

Group pressure for consensus development may not be true consensus, feedback mechanism may lead to conformity rather than consensus, no accepted guidelines for determining consensus, sample size, and sampling techniques, outcomes are perceptual at best, requires time and participants commitment, possible problem in developing initial questionnaire to start the process, potential dangers of bias such as selection criteria for panel and manipulation by researchers, time delay between rounds in data collection process, dropout, and response rate are the major weakness and challenge in Delphi process. There are five main challenges in Delphi process.

Low Response Rate

Low response rate is one of the major methodological challenges in Delphi process. The response rate in Delphi process is sometimes low due to multi-round nature where experts need to participate in a number of iterations. Delphi process usually needs to achieve optimum initial response rate and maintain a high response rate in each subsequent iteration. Being unable to retain qualified available experts and being unable to achieve an ideal response rate may affect the validity of Delphi process. To overcome non-response rate, different strategies can be applied. The response rate can be increased using an online version of the questionnaire with instructions and use of wireless audience participation system maximizes the response rates and expedites the consensus development among experts. The response rate in the round II was the highest using online Google form, whereas it was the lowest in face to face round III. Internet-based rounds avoid the need for face-to-face meeting of the experts. Internet-based response system increases the response rate due to its less time-consuming nature, and it has also the potential to offer more content validity by improving ethics in research by ensuring anonymity and confidentiality.^[31]

Follow-up by telephone and email in each round helped to increase response rate. At least two follow-ups were carried out. Other strategies to deal with non-response rate in Delphi process are as follows: To use assistance from endorsed individuals who are influential or famous or renowned in the area of investigation, initial contact in phone before requesting participation in round I, and constructing an easy and less time-consuming questionnaire.^[32]

Identification and Selection of Experts

Identification and selection of experts are another methodological challenge in Delphi process. Experts in Delphi process are knowledgeable in a field, subject matter expertise who can provide opinion on the issue under investigation. Delphi process relies on the opinion of experts which is crucial for consensus development and future direction. Therefore, identification and selection of appropriate experts in Delphi process maximize the quality of responses and reduce bias as well as builds credibility in the results.^[6] However, a recent Indian study revealed that participants having more than 10 years of experience were more inconsistent and changed their response in the successive rounds of Delphi process (Raghav and Bhardwaj, 2016). Two major problems in selecting experts in Delphi are a differentiation between levels of expertise for consensus development and the relevancy of experts in the subject area where subject matters are cultural value rather than technology.^[6] To overcome selection bias and non-response rate, as previously discussed, a four-step selection procedure was used.

Experts Time Constraint for Participation in Successive Rounds

Getting experts' time for three or more successive rounds was also a methodological challenge in Delphi process. Delphi process required multiple rounds to develop consensus among participants which requires a great deal of time and many participants drop out during process. Furthermore, the response rate of participants decreases for each round of the process, and more number of reminders were needed in the process, round I was completed with 80% response rate, round II was completed with 85% response rate, but round III was completed with only

45% response rate. It showed the response rate was moderate in first qualitative round, high in online quantitative round II, and low in physical presence round III.

Logistic Management

Logistic management to bring busy panelist together at a same time is one of the major non-methodological challenges in Delphi process. In one of the studies conducted of 19 people invited, only six members comprised in final panel due to time pressure as a primary reason for non-participation.^[6] In this instrument development process, also 34 respondents who participated in round II were invited for round III panel discussion but only 15 experts participated. The first reason was time constraint to attend discussion due to busy schedule on that particular day, and some of them felt venue was not appropriate for them.

Time-consuming Nature

One of the non-methodological challenges in Delphi process was its time-consuming nature. Delphi process was conducted in sequential and iterative manner, and each step needs to allow enough time (at least two weeks gap) to maximize the response rate. Hence, it required enough time between iterations. The gap between two rounds of the Delphi process provides investigators and panelists to improve accuracy of the results, but it also increases the duration of the Delphi process and lengthy process may result in participants attrition.

This tool development process took 4 months. However, many experts in final face-to-face round were unable to participate in panel discussion program. It reduced experts' inputs in the final consensus development stage. Each participating expert also had their own area of specialization in adolescents and youth issues; therefore, many experts' responses in the first round were specific to a particular issue rather than broad-risk behavior issues. This process was conducted by involving national and local experts from Nepal, and the field survey to support grounded theory was carried out in two municipalities of Nepal, so generalizability of the result might not be suitable in other part of the regions where the context are different. Systematic literature review in different databases was not done due to time constraint, so relevant literature might have been missed during the search process. Grounded theory was carried out by randomly selecting two schools where total of 10 students were selected from science and management stream of Higher Secondary School for in-depth interview. It would be more representative if students from Humanities, and other stream were also selected to understand local context.

Different instrumental development approaches have been used across the world in sensitive issues such as risk behavior. Risk behavior tool development processes have generally been based purely on literature review and item reduction by collaborative group members and content experts. For example, in development of an upper extremity outcome measure, an initial pool of 821 potential items was generated through extensive literature search, and items were reduced to 177 by expert's judgment or opinion. Such instruments may not be compatible with cultural and social context. A study conducted in Iran used the ecological framework for the development of the questionnaire which confirmed the cultural and social condition to predict protective sexual behavior of women at risk of HIV. The process started with a qualitative

study which involved in-depth interview with women at risk. The initial pool of items was generated on the basis of in-depth interview and literature review. To verify the questionnaire, qualitative face validity, content, and construct validity were assessed where many items inappropriate content validity ratio and index were deleted before assessing the reliability of the instrument as in the Delphi process of this study.

In other study, items were generated while developing the adolescent exploratory and risk behavior rating scale (AERRS) through literature review using computerized databases such as Psycho INFO and ERIC and existing risk behavior questionnaire. The AERRS designed to measure participation in risk behavior and perception of risk behavior. The participation was designed to measure in 1 (never) to 4 (often) Likert scale. The validation of the items selected was performed using item response theory, and the analysis was done by factor analysis, correlations, and coefficient alpha analyses.

This study used general descriptive statistics in Delphi process to identify the HRB determinants based on classical Delphi process and identified HRB determinants are based on Nepalese context. Further testing identified HRB determinants would help in tool development and to identify more generalizable findings in adolescent HRB and its determinants.

CONCLUSION

The Delphi method supplemented by literature review and grounded theory is designed to help to get consensus between expert panels. The process helped to get more valid tool based on local context and previous researches. The Delphi methodology is an effective approach for investigating the problems with the help of judgments of expert panelists. The view of expert panelists was further cross-checked with other research by literature review and with grounded theory by in-depth interview with adolescents.

This article described the Delphi process during instrument development. Furthermore, HRB determinants which were not identified in Delphi process but were relevant to local context were identified through grounded theory. Major determinants were also cross-checked with the previous research items.

Delphi techniques supplemented with grounded theory and literature review can be useful for developing the instrument on HRB and its determinants. The whole process helped to establish face and content validity of the instrument. Many challenges while developing the instrument can be overcome or can be minimized.

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