A STUDY TO ILLUSTRATE DECAY IN HIGH ANGLE ROPE RESCUE THEORY AND PSYCHOMOTOR SKILLS

A research project presented to the

Faculty of Health Sciences, University of Johannesburg
in fulfillment of the
Baccalaureus Technologiae Degree
Emergency Medical Care

by

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DECLARATION

I declare that this project is my own, unaided work. It is being submitted for the Degree of Baccalaureus Technologiae at the University of Johannesburg. It has not been submitted before for any degree or examination in any other Technikon or University.

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ABSTRACT

Currently South African Paramedic's completing the National Diploma Emergency Medical Care (N. Dip EMC) are trained in both Emergency Medical Care and Medical Rescue. Although no research has been conducted to assess the extent of high angle rope rescue theoretical knowledge and psychomotor skills decay, data on skills such as cardiopulmonary resuscitation and intubation show a rapid and linear decay over time.

The aim of this study was to illustrate decay in high angle rope rescue theoretical knowledge and psychomotor skills by N. Dip EMC learners, or graduates, after a time period of 35 months.

The sample group comprised the N. Dip EMC undergraduate class of 2003. There were no absolute exclusion criteria other than unsuccessful completion of the high angle II rescue module during 2003.

The participants were required to complete: A High Angle Questionnaire which provided information regarding the frequency of use of high angle skills post high angle II rescue module, a Theory question taken from the 2003 final high angle II theory examination and 2 Objective Structured Practical Examinations taken from the 2003 final high angle II practical examination.

The results of this study show that there is decay in the retention of high angle rescue theoretical knowledge and psychomotor skills over a period of 35 months. Evidence of this is shown through the results gathered from all areas of this study when compared to the final outcomes of the 2003 examinations.

ACKNOWLEDGEMENTS

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CPD: Continuing Professional Development

CPR: Cardiopulmonary Resuscitation

ECA: Emergency Care Attendants

EMS: Emergency Medical Services

EMT-A: Emergency Medical Technician

EMT-P: Emergency Medical Technician – Paramedic

LMA: Laryngeal Mask Airway

N. Dip EMC: National Diploma Emergency Medical Care

OSPE: Objective Structured Practical Examination

TWR: Technikon Witwatersrand

UJ: University of Johannesburg

LITERATURE REVIEW

In South Africa, Paramedics completing their National Diploma Emergency Medical Care are trained in Emergency Medical Care and Medical Rescue as the two major subjects to be completed throughout each year of study (University of Johannesburg, 2006). The inclusion of Medical Rescue is intended to result in a well rounded Paramedic Graduate. Traditionally, the short course route of attaining a Paramedic qualification has excluded medical rescue thus concentrating only on the emergency medical aspects of patient care.

Human skills vary greatly and include: perceptual motor skills such as typing, athletic skills, musical skills and cognitive skills such as computer editing and playing chess. The development of skill requires a large amount of deliberate practice. Skills are almost always tested by the subject's ability to perform the requisite activity at some level of competence (Bower, 2000). Skill memories are learned motor behaviours. The complex motor (or psychomotor) skills that would be used during a rescue exercise involve the integration of motor patterns in the cerebral nuclei, cerebral cortex and cerebellum (Martini, 2001).

The degree of competence to which an acquired skill is retained through the passage of time is called "skill retention" and the degree of loss of competence of a skill is termed "skill decay" (Farr, 1987). Many medical rescue tasks are of a complex nature, requiring high levels of psychomotor skill on the part of the practitioner. Most graduating practitioners fill clinical posts and are not often required to utilise many of their acquired rescue skills (Justus, 2002). Retention of skill proficiency is directly related to frequency of use of that specific skill (Latman and Wooley, 1980). Payne and Wenger (1996) found that recall performance is also directly related to the number of tests administered for the specific skill as the act of recalling increases the accessibility of the skill. No research studies have been conducted in South Africa on medical rescue skills decay, retention and recall.

In some professions requiring the application of complex psychomotor skills, such as within the Military or Commercial Aviation industry, mandatory and in some cases legislative processes are in place to examine the retention of skills performed in the operational environment (Ginzburg and Dar-El, 2000; South African Civil Aviation Authority, 1998).

As already mentioned, there is a lack of medical rescue research available with regards to skills decay, retention and recall. There is, however, data available on clinical psychomotor skills such as cardiopulmonary resuscitation (CPR) and intubation that could be relevant to skill decay, retention and recall in general.

McKenna and Glendon (1985) reported that there was a rapid and linear decay in basic CPR skills over time, with fewer than 20% of subjects achieving a score of 75% on performance after 6 months posts training. Further research showed evidence of overwhelming basic CPR skill decay over time (Glendon *et al*, 1988). Berden *et al* (1993) measured basic CPR retention skills at 3, 6, 9 and 12 month intervals and concluded that reinstruction at 6 monthly intervals was necessary to maintain adequate skills in CPR.

Latman and Wooley (1980) provide an analysis of the knowledge and skill retention of Emergency Care Attendants (ECA), Emergency Medical Technician (EMT)-A's and EMT-P's. The sample represented 4.1% of the total number of practitioners trained and certified in these positions in Texas, United States of America. Across the board the average didactic knowledge loss was reported as 10%. Basic skills proficiencies, however, were markedly reduced by 55% in the ECA category, 50% in EMT-A's and 61% in EMT-P's. From the results, the authors concluded that the retention of knowledge and skill appears to be directly related to frequency of use. In this same study it was reported that practitioners participating in continuing education programs experienced an 11% better retention average for skills than non-participants. Practical skills appear to decline more rapidly than theoretical knowledge (Skidmore and Urquhart, 2001). According to Young and King (2000) as well as Su *et al* (2000) refresher courses based only upon knowledge do not prevent decay in psychomotor skills.

Currently, the Health Professions Council of South Africa Continuing Professional Development (CPD) requirements for Emergency Care personnel are purely voluntary based, however a reconfigured CPD programme is being piloted by 3 Professional Boards (Dietetics, Medical and Dental as well as Radiography and Clinical Technology) to smooth out the implementation before the anticipated launch as a requirement for all Professional Boards (Health Professions Council of South Africa, 2006).

In a more recent study, skills retention for the insertion of the Combitube and Laryngeal Mask Airway (LMA) was assessed (Vertongen *et al*, 2003). Subjects were taught the techniques of insertion and ventilation for both devices initially and then reassessed within 1 month and then again 6 months after the initial training. Assessment 1 month after training showed that 90% of all participants successfully ventilated a manikin using the LMA and 92% using the Combitube. When tested again after 6 months further decay in skill proficiency was observed as successful ventilation using the Combitube was only achieved in 77% of attempts and the LMA in 85% of attempts.

Although the research discussed above is not specifically on medical rescue skills, the results suggest that frequent retraining in both theory and practice is required to maintain psychomotor skills proficiencies in a variety of operational settings. According to the International Liaison Committee on Resuscitation, European Resuscitation Council and American Heart Association (2005) the optimal period for retraining has still not been established.

The results of this study clearly highlight that high angle rope rescue theoretical knowledge and psychomotor skills do decay over a period of time. Only 9.09% of study participants were found to be COMPETENT in all aspects of the study i.e. they successfully completed the theory question and the 2 OSPE's. This equated to an overall 90.91% NON COMPETENT result.

AIM

The aim of this study was to illustrate decay in high angle rope rescue theoretical knowledge and psychomotor skills by National Diploma Emergency Medical Care learners, or graduates, after a time period of 35 months.

METHODOLOGY

SAMPLE GROUP

The study population was the National Diploma Emergency Medical Care (N. Dip EMC) undergraduate rescue class of 2003, all of whom were a minimum of 35 months post successful completion of the high angle II rescue module. This class was selected due to the largest number of successful participants completing the high angle rescue II module in recent years which translated into the largest convenience sample available to participate in this study. There were no absolute exclusion criteria other than unsuccessful completion of the high angle II rescue module during 2003.

Participation in this study was totally voluntary and participants were informed that they could withdraw at any time. Participants were all approached personally and invited to take part in the study which was conducted at the University of Johannesburg (UJ), Doornfontein Campus. Participants had no prior knowledge of the fact that they would be assessed, or what was to be assessed, on the day of the study so as to avoid participants preparing for the assessment and affecting the results. The entire research procedure was explained to all prospective participants, on the day, before signed consent was obtained. All data collected, as well as personal participant results, have been kept strictly confidential. No published information contains any specific references or identifying data to the respective study participants. Participant numbers were allocated to each respective study participant in order that published results were kept anonymous. The results of the study are available to participants on request.

The skills undertaken in this study posed no safety or personal injury risks to any of the participants or examiners.

RESEARCH PROCEDURE

Participants presented themselves at the arranged venue at the UJ.

The aim of the research as well as the research procedure was explained and participants were requested to sign a Participant Information and Consent Form (Appendix A).

A High Angle Questionnaire that provided information regarding the frequency of use of high angle skills (Appendix B) was then completed by each participant. Although use of any high angle skills in the past 35 months did not exclude any participant from the study, this information was extremely important when evaluating the extent of theoretical and psychomotor skill decay, if any.

A theory question selected from the final 2003 theory examination paper (Appendix C) was then completed by each participant. A maximum time limit of 10 minutes was set to complete the question.

After completion of the questionnaire and theory question all participants were requested to remain in a designated holding area and two participants were selected randomly at a time to complete either OSPE Station 1 or 2, and then rotate between OSPE stations.

The Objective Structured Practical Examinations (OSPE) were selected from the final 2003 High Angle II Practical Evaluation. OSPE Station 1 comprised a stretcher rigging exercise (Appendix E) and OSPE station 2 required participants to construct and operate a pulley system (Appendix E). Both OSPE's had a 20 minute time limit and were preceded by an Assessment Brief (Appendix F) handed to each participant outlining the respective OSPE assessment requirements and equipment available for acknowledgement and signature.

DATA COLLECTION AND ANALYSIS

The High Angle Questionnaire provided the researcher with information regarding frequency of use of high angle skills for all participants.

For the theory question, participant's answers were marked against the 2003 final high angle II theory examination marking memorandum (Appendix D) for the same question. The question was marked out of a total of 8 marks and participants had to obtain a minimum of 4 marks to pass the question.

Study participants were then examined according to predetermined OSPE examination sheets taken from their 2003 final high angle II practical examination (Appendix E). The data collection instrument and procedure was free of bias and provided an accurate reflection of the participant's performance. The participant was either able to perform the procedure or not.

All OSPE results were compared to each participant's respective final OSPE examination sheets, as completed during 2003, with results calculated from each line item as reflected on the respective OSPE sheets. Results were detailed as either "*YES – COMPETENT* or *NO – NOT COMPETENT*".

Once all results were collected from all 3 aspects of this research project i.e. the theory question and the 2 x OSPE's these were transcribed into a global results spreadsheet (Appendix G) for analysis purposes. Participants had to successfully complete and be found COMPETENT in all 3 areas to have an overall result as COMPETENT. Any participant who was unsuccessful and found NOT COMPONENT in 1 or more of any of the aspects of this research project had an overall result of NOT COMPETENT.

RESULTS

PARTICIPANTS

A total of 15 learners enrolled for the High angle II rescue module during 2003. One learner failed the module and therefore 14 (93%) learners completed the module successfully and were therefore eligible for this research project.

Twelve (80%) learners, some now N. Dip EMC graduates, confirmed their availability to participate in this study, however only 11 (73%) arrived on the day with 1 (7%) withdrawal on the day of the data collection.

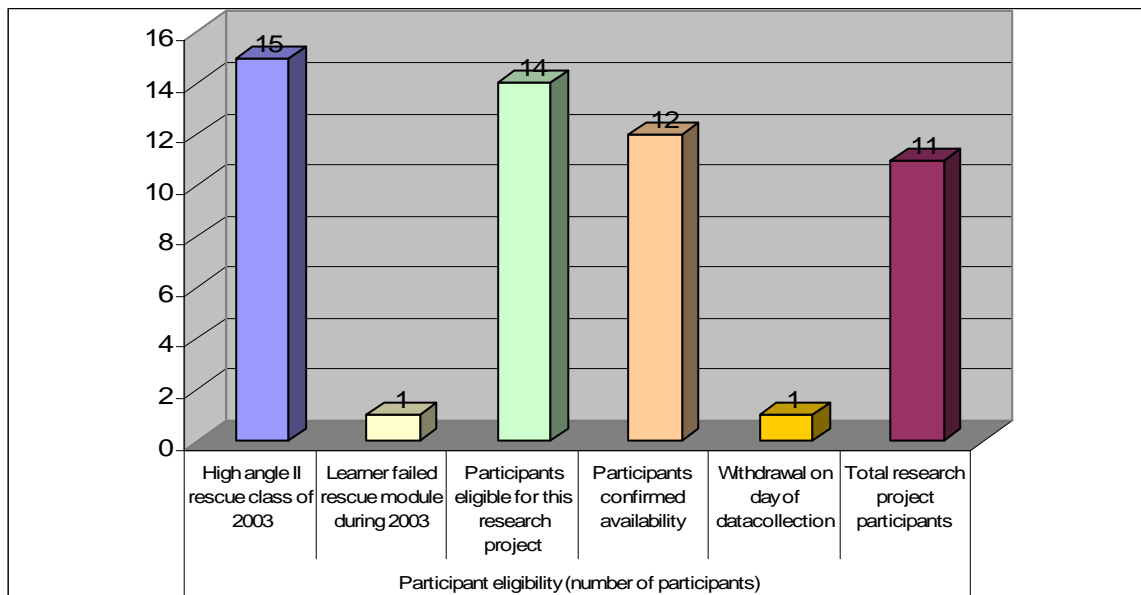Gender and age were not considerations in this study.

Figure 1: Participant Eligibility

HIGH ANGLE QUESTIONNAIRE

Question 1

Have you undertaken or actively participated in a / any high angle rope rescue/s since completing the National Diploma Emergency Medical Care high angle II rescue module ?

- YES: 2 (18.18%) participants
- NO: 9 (81.82%) participants

Figure 2: Active Participation in High Angle Rescues

Question 2

Do you undertake any full, or part-time employment, or related activities that involves the use of climbing ropes and / or safety rigging ?

- YES: 2 (18.18%) participants
- NO: 9 (81.82%) participants

Figure 3: Employment, or Related Activities, Involving High Angle Rescue

Question 3

Have you attended a formal high angle rope rescue update since completing the National Diploma Emergency Medical Care high angle rescue II module ?

- YES: 0 (0%) participants
- NO: 11 (100%) participants

Figure 4: Attendance of any Formal High Angle Rescue Updates

Question 4

Have you attended any informal "In-service" practical high angle rescue sessions since completing the National Diploma Emergency Medical Care high angle rescue II module ?

- YES: 2 (18.18%) participants
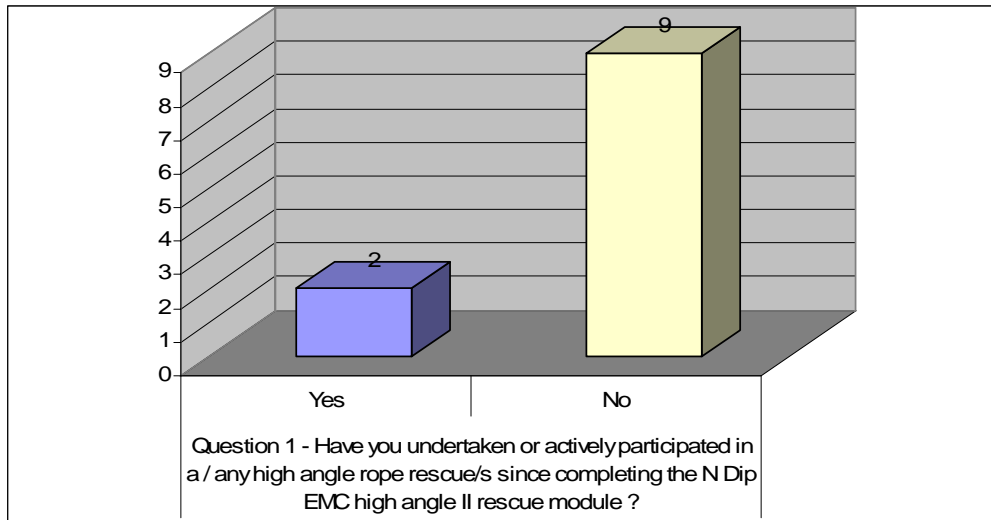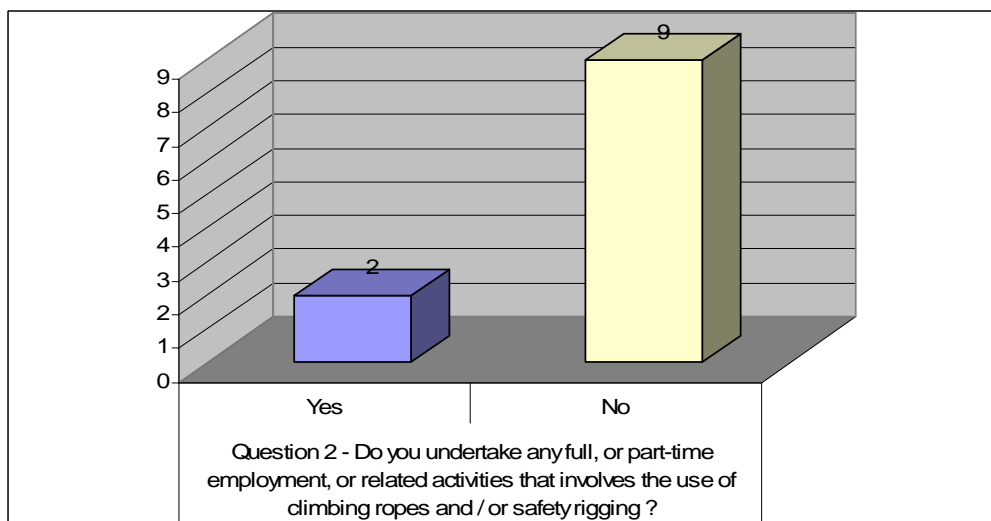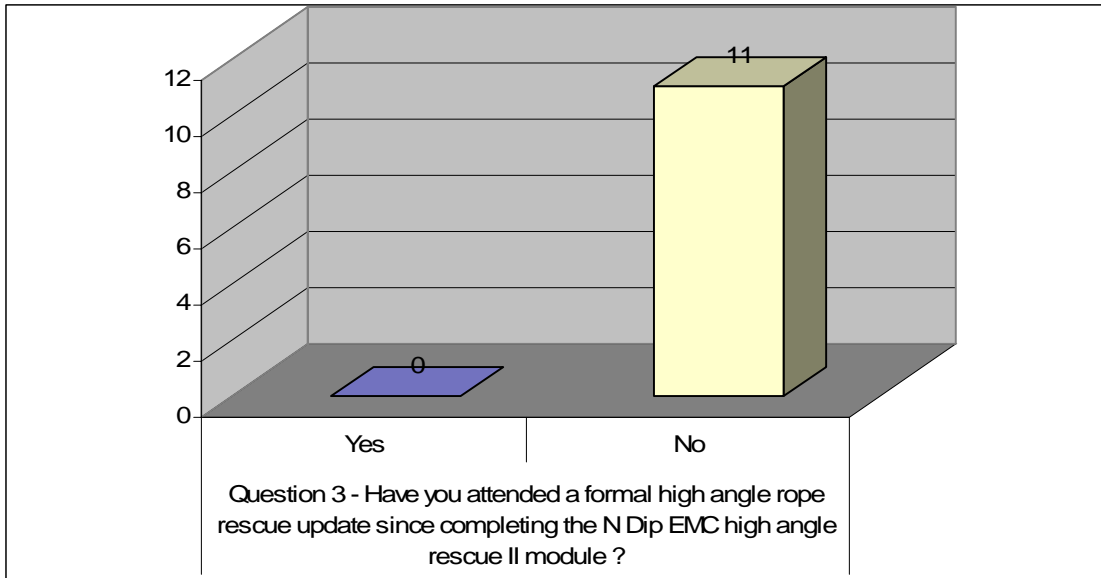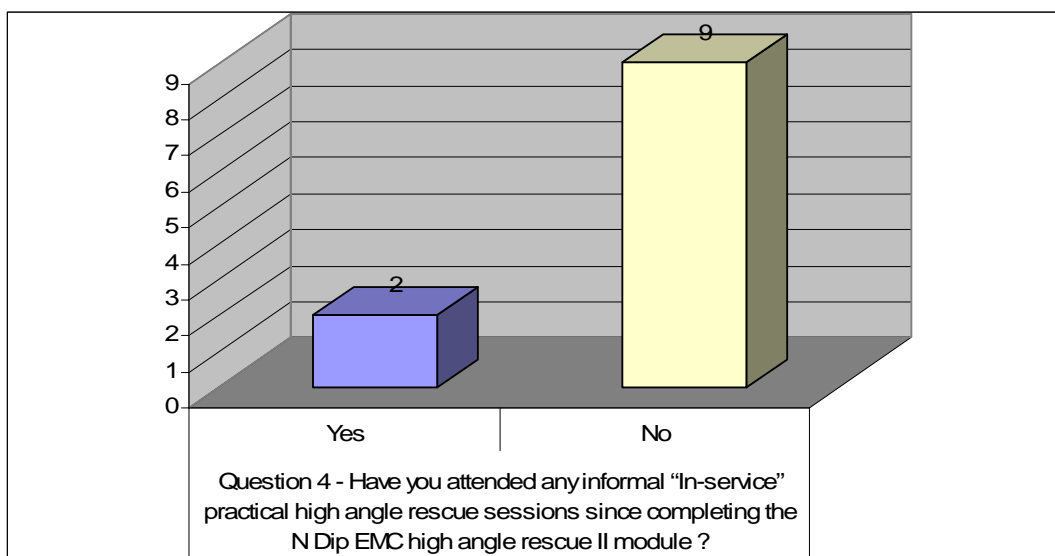- NO: 9 (81.82%) participants

Figure 5: Attendance of any Informal "In-service" High Angle Rescue Updates

Question 5

Have you completed any other rescue courses / modules that require the use of high angle rescue skills ?

- YES: 11 (100%) participants
- NO: 0 (0%) participants
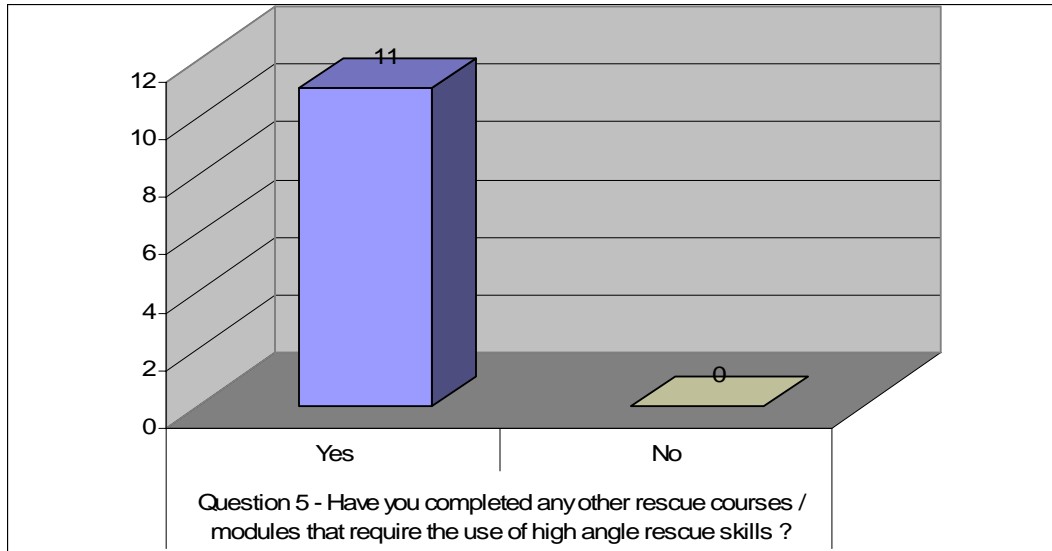
Figure 6: Other Rescue Courses

Question 6

How would you rate your current practical ability and confidence to perform high angle rope rescue skills ?

- Not confident or able at all: 2 (18.18%) participants
- Able, but not very confident: 9 (81.82%) participants
- Able and confident: 0 (0%) participants
- Very confident: 0 (0%) participants
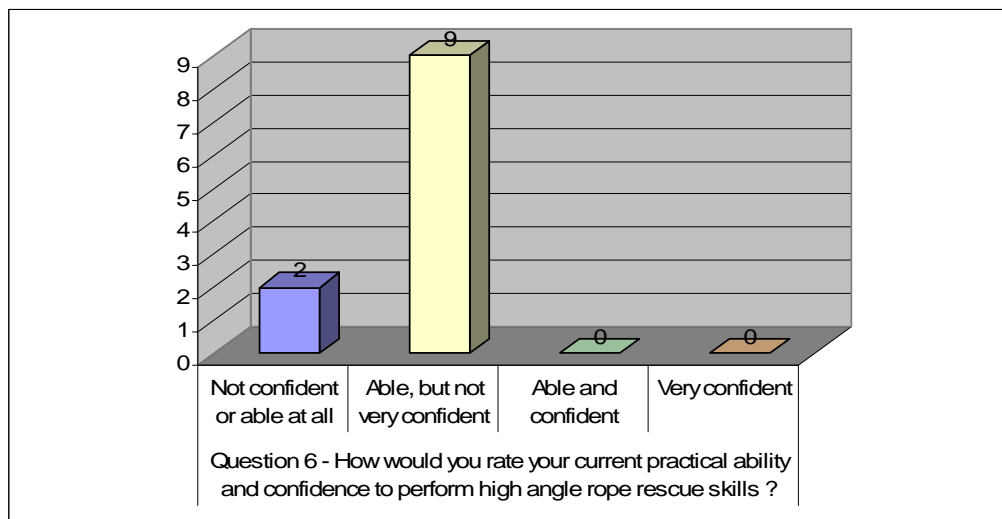
Figure 7: Rating of Current Practical Ability and Confidence

Question 7

How would you rate your current theoretical knowledge of high angle rope rescue ?

- Very Poor: 2 (18.18%) participants
- Poor: 9 (81.82%) participants
- Good: 0 (0%) participants
- Very Good: 0 (0%) participants
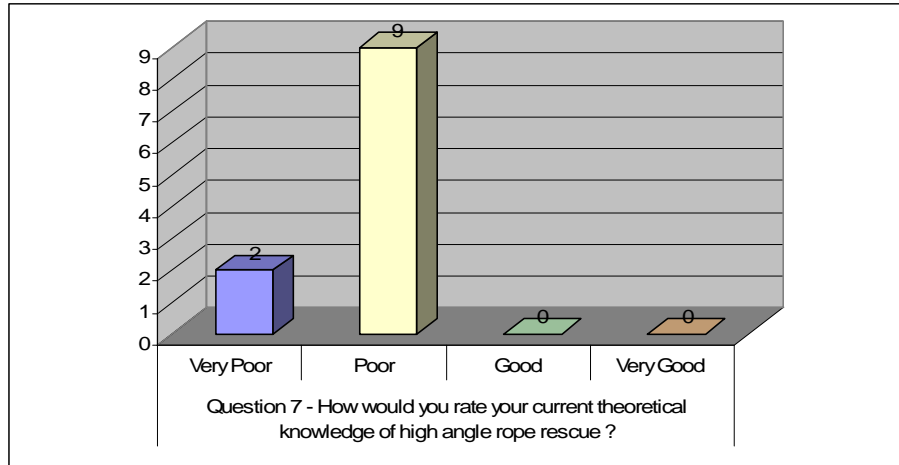
Figure 8: Rating of Current Theoretical Knowledge

Question 8

Who are you currently employed by ?

- Government EMS / State Department: 1 (9.09%) participant
- Local Authority EMS: 1 (9.09%) participant
- Private EMS: 5 (45.45%) participants
- Private Business: 0 (0%) participants
- Student: 4 (36.36%) participants
- Unemployed: 0 (0%) participants
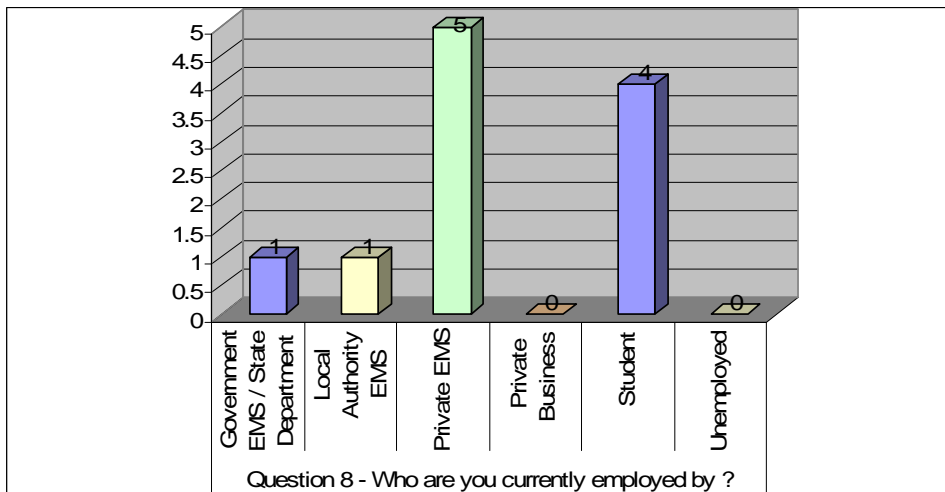
Figure 9: Current Employment

THEORY QUESTION

- COMPETENT (>50%): 7 (63.64%) participants
- NOT COMPETENT (<50%): 4 (36.36%) participants

- Average mark 2006: 4½ / 8 (56.25%) participants
- Final 2003 examination average mark: 6.7 / 8 (84%) participants
- Mark difference (2006 compared to 2003 results): 2.2 (27.5%) marks
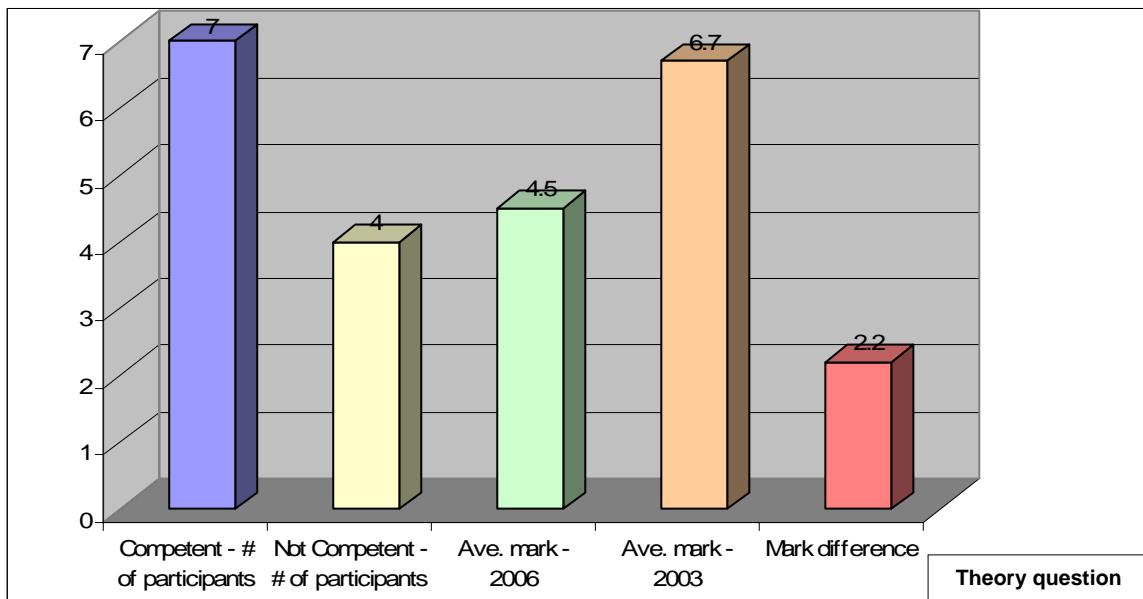
Figure 10: Theory Question Results

OBJECTIVE STRUCTURED PRACTICAL EXAMINATIONS

STRETCHER RIGGING:

- COMPETENT: 4 (36.36%) participants
- NOT COMPETENT: 7 (63.64%) participants
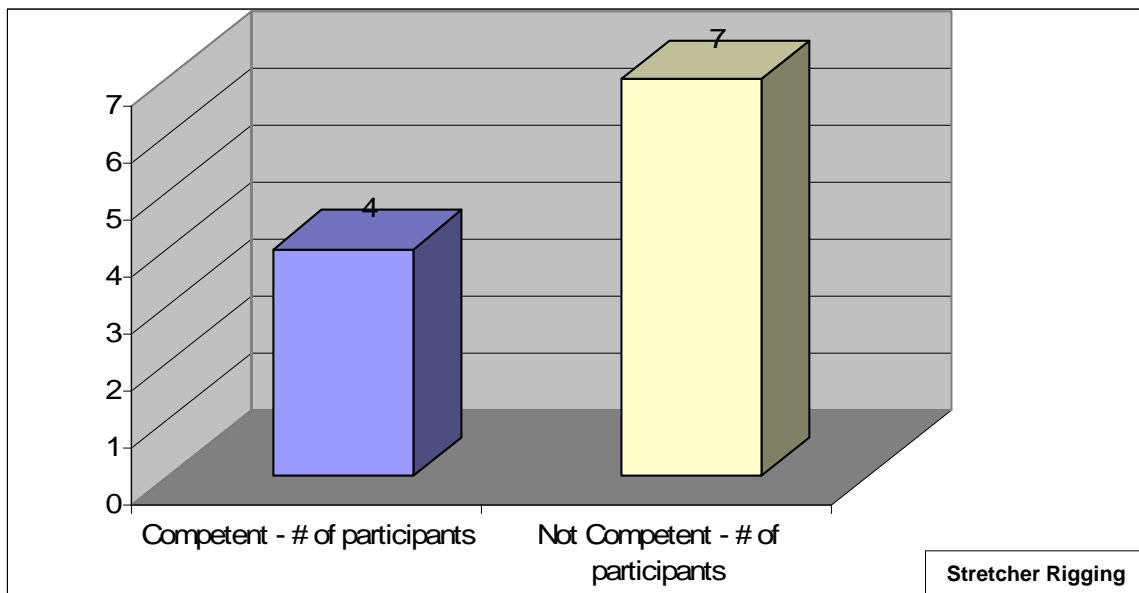
Figure 11: Stretcher Rigging OSPE Results

PULLEY SYSTEM:

- COMPETENT: 3 (27.27%) participants
- NOT COMPETENT: 8 (72.73%) participants
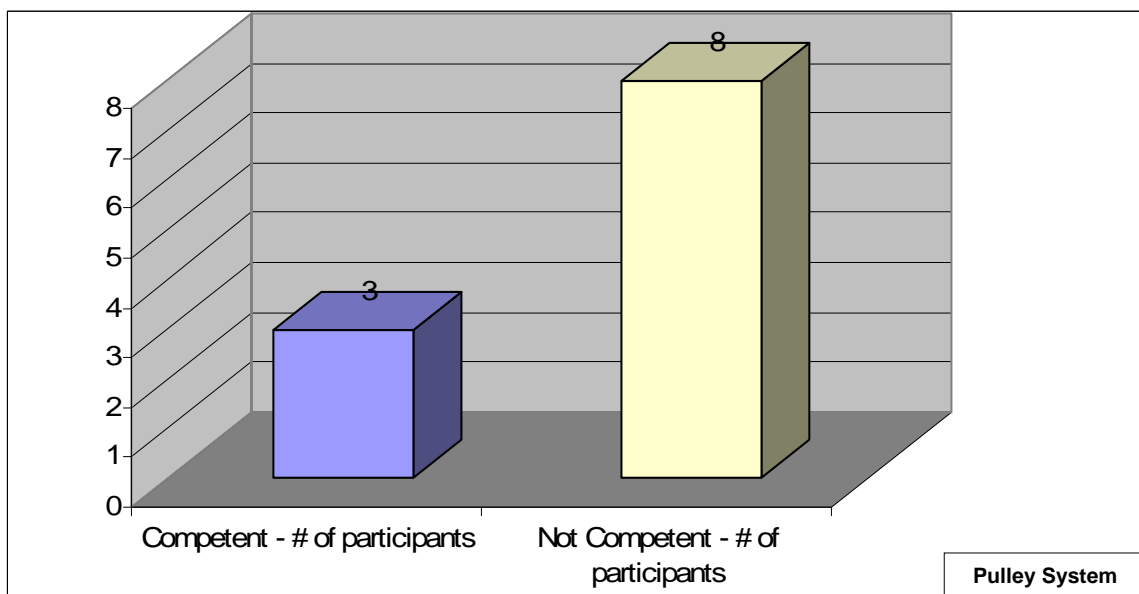
Figure 12: Pulley System OSPE Results

OVERALL RESULTS

- COMPETENT: 1 (9.09%) participant
- NOT COMPETENT: 10 (90.91%) participants

- One (9.09%) participant completed all 3 components of the research study successfully
- One (9.09%) participant was found "Not Competent" in all 3 components of the research study
- Two (18.18%) participants were found "Not Competent" in 1 component of the research study
- Seven (63.64%) participants were found "Not Competent" in 2 components of the research study
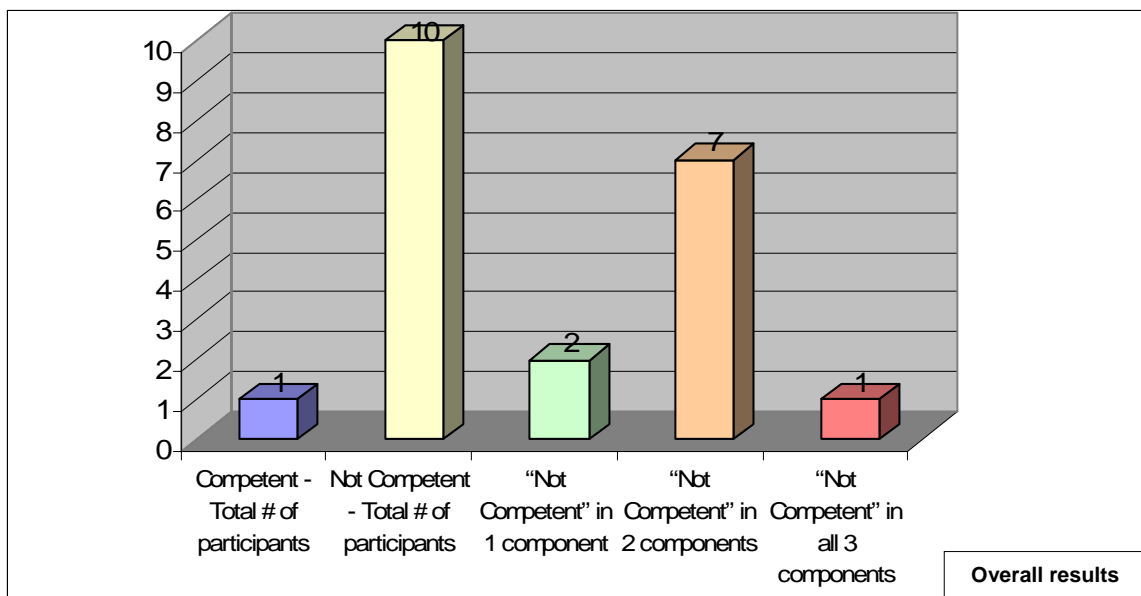
Figure 13: Overall Results

DISCUSSION

The results of this study show that there is decay in the retention of high angle rescue theoretical knowledge and psychomotor skills over a period of 35 months. Evidence of this is shown through the results gathered from all areas of this study when compared to the final outcomes of the 2003 examinations.

QUESTIONNAIRE

The information obtained from the High Angle Questionnaire completed by all participants showed that only 18.18% had either actively participated in a high angle rope rescue operation or were involved in any rope safety rigging / climbing related activities since completing the high angle rope rescue module in 2003. This demonstrates that high angle rescue psychomotor skills are not often used and as such 81.82% of the participants have not used these skills learnt since successful completion of the high angle rescue module in 2003.

The questionnaire also determined that none of the participants had attended a formal high angle rope rescue update since completing the high angle II rope rescue module in 2003 i.e. 35 months back. Only two participants (18.18%) had been involved in some form of informal "in-service" practical high angle rescue training sessions. It was however interesting to note that all participants had completed other rescue courses / modules post completion of the formal high angle rescue II course during which high angle rescue skills had to be used. These additional rescue courses / modules included confined space rescue, aquatic rescue, aviation rescue, swift water rescue and structural collapse rescue and were all completed between the remainder of 2003 to mid 2005 (other rescue course / module completion time varied from participant to participant) which shows that all participants were in fact exposed to high angle rescue skills post the high angle II rescue module being completed in April 2003.

Most participants (81.82%) felt that they would be able to, but not very confidently, perform most high angle rope rescue skills at the time of this study. Only 18.18% believed that they would not be able, nor were they confident enough, to perform any high angle rope rescue skills.

When requested to rate their current theoretical knowledge 81.82% of participants stated that their theoretical knowledge was poor, with the remaining 18.18% rating their theoretical knowledge as very poor.

Most (45.45%) of the study participants currently work for private Emergency Medical Services within South Africa which may explain the lack of exposure of this specific group of participants to high angle rescue equipment, actual scenarios and updates. However 36.36% of participants are still undergraduate students all of whom are currently completing their final year of study towards the National Diploma: Emergency Medical Care and as such have access to a wide variety of high angle rope rescue equipment and instructors to ensure maintenance of these skills should they so wish. The remaining 18.18% of participants either worked for Local Authority Emergency Medical Services agencies or Government Emergency Medical Services / State Department (Military). Exposure to high angle rescue in these categories would greatly depend upon what role these participants play within their respective workplaces as these tend to have relatively rigid job descriptions. All of the participants, save the students, are involved in a clinical role as their primary daily work function, as concurred by Justus, 2002.

THEORY QUESTION

The question selected for this study was successfully completed by all study participants during the final 2003 examinations with all achieving a mark above 50%. The average mark was 6.7 out of a possible 8 marks (84%).

The average mark obtained during this study dropped to 4.5 out of a possible 8 marks (56.25%) with only 63.64% of participants obtaining a mark above 50%. The remaining 36.36% of participants obtained marks below 50% and thereby effectively failed the theory question.

All participants completed the question within the allocated time frame of 10 minutes.

These results indicate that the study participant's high angle rescue theoretical knowledge has decayed over the 35 month time period which is inline with what was reported by Latman and Wooley (1980) whereby they too demonstrated a didactic knowledge loss over time.

OBJECTIVE STRUCTURED PRACTICAL EXAMINATIONS

Two of the 3 final 2003 high angle II Objective Structured Practical Examinations (OSPE) were re-examined during this study, namely "Stretcher rigging" and "Pulley systems". Both OSPE's selected for this study were successfully completed by all study participants during the final 2003 examinations.

STRETCHER RIGGING

The outcomes of this OSPE concluded that only 36.36% of study participants were found to be COMPETENT in completing the OSPE successfully during the allocated time of 20 minutes. The remaining 63.64% of participants were unsuccessful in their attempts to complete the OSPE and found to be NOT COMPETENT.

Two areas of concern were highlighted from this study with regard to this OSPE namely:

1) *Patient has head, eye and respiratory protection*: 54.55% of study participants neglected to ensure that the necessary protection for the patient was forthcoming.

2) *System safe and functional*: 63.64% of study participants were not able to rig a stretcher system that was ultimately safe and functional.

Both the aforementioned are critical safety issues in performing, and successfully completing, the task at hand. Patient safety and protection is of paramount importance and of even greater importance is the ultimate ability to rig a safe and functional stretcher system as if this cannot be successfully undertaken the patient cannot be hoisted safely.

The average time to complete this OSPE was 16 minutes and 45 seconds, with the minimum completion time being 11 minutes and the maximum exceeding the cutoff time of 20 minutes – this compared to a successful completion time of just 8 minutes by the examiner. This clearly indicates that when skills proficiencies are maintained the time required to rig a stretcher system is markedly reduced – in this case by up to 50% if one compares the study participant's results to the examiners.

Candidates were asked to rate their own performance post completion / termination of the OSPE to which 54.55% rated themselves as COMPETENT with the remaining 45.45% rating themselves as NOT COMPETENT.

PULLEY SYSTEM

The outcomes of this OSPE concluded that only 27.27% of study participants were found to be COMPETENT in completing the OSPE successfully during the allocated time of 20 minutes. The remaining 72.73% of participants were unsuccessful in their attempts to complete the OSPE and found to be NOT COMPETENT.

Two areas of concern were highlighted from this study with regard to this OSPE namely:

1) *Able to safely change from a hoisting to a lowering system*: 54.55% of study participants were not able to successfully accomplish this task.

2) *Able to lower the load safely and efficiently to the ground*: 72.73% of study participants were not able to successfully accomplish this task. This outcome is inline with the final result for this entire OSPE.

The average time to complete this OSPE was unfortunately unclear due to limited recording of times by the examiner.

Candidates were asked to rate their own performance post completion / termination of the OSPE to which 36.36% rated themselves as COMPETENT with the remaining 63.64% rating themselves as NOT COMPETENT.

If one takes the combined result of the 2 OSPE's the following results are deduced:
1) 31.81% of this study's participants where found to be COMPETENT on a psychomotor skills level after a period of 35 months of successful course completion
2) 68.19% of this study's participants where found to be NOT COMPETENT on a psychomotor skills level after a period of 35 months of successful course completion

Judging by the frequency of use of high angle rescue skills as detailed in the participant's questionnaire, it appears that the retention of skills proficiency could be related to the frequency of use and testing of the specific skill/s in question (Latman and Wooley, 1980; Payne and Wenger 1996); backed by the actual practical psychomotor skills performance by this study's participants it appears that practical psychomotor skills performance does in fact decay with time as highlighted and detailed by McKenna and Glendon (1985); Glendon *et al* (1988) and Skidmore and Urquhart (2001).

LIMITATIONS
1) The small sample size for this study may have influenced some findings, however undergraduate class size was the determining factor in this regard and the class of 2003 provided the only reliable and representative study population of substance for this research project.
2) The 35 month time period from successful completion of the high angle II rescue module to the time of this study has limiting factors in terms of refreshing high angle rescue theoretical knowledge and skills.

3) One needs to equate the findings to a shorter period of time post course / module completion with increased numbers of course / module graduates in order to accurately ascertain what the ideal time period would be for refreshing of high angle rescue skills ?

The literature details that post a time period of 6 months (McKenna and Glendon, 1985 and Berden *et al*, 1993) a rapid and linear decay of CPR skills was observed, such skills that require similar if not the same psychomotor ability for the performance of a high angle rescue and that reinstruction at 6 monthly intervals is necessary to maintain adequate skills.

CONCLUSION

The results of this study clearly highlight that high angle rope rescue theoretical knowledge and psychomotor skills do decay over a period of time. Only 9.09% of study participants were found to be COMPETENT in all aspects of the study i.e. they successfully completed the theory question and the 2 OSPE's. This equated to an overall 90.91% NON COMPETENT result.

There is a definite need for high angle rescue CPD programs to maintain proficiency in high angle rope rescue skills especially if Medical Rescue becomes a registerable qualification with the Health Professions Council of South Africa. Should these registrations occur it could be worthwhile to investigate the possibility of launching Medical Rescue CPD from the outset coinciding with the inception of medical rescue registrations.

Further studies need to be conducted on larger sample groups in order to ascertain what the ideal timing would be for high angle refresher training – from both a theoretical and practical psychomotor skills perspective.

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