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An Evaluation of Qualities of Nuclear Medicine Technology Programs and Graduates Leading to Employability

Cybil J. Nielsen[1], Sarah S. Brosmer[1], Patrick J. Byrne[1], S. Gregory Jennings[1]

Author Note:

Cybil Nielsen, Assistant Clinical Professor, Department of Radiologic and Imaging Sciences, Nuclear Medicine Technology Program, Indiana University School of Medicine.

Correspondence concerning this article should be addressed to Cybil Nielsen, 721 E. North St. 3A Indianapolis, IN. Contact: cybniels@iupui.edu and/or (317)274-7431.

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1. Indiana University School of Medicine

Abstract

Rationale: To evaluate the association between qualities of nuclear medicine technology (NMT) programs and graduates, and employability. **Methods:** We identified all NMT certification board applicants who passed the entry level NMT exam between 2012 and 2017. Certificants were e-mailed a survey with questions regarding graduate qualities, program qualities, and initial employment. Each quality was quantified. Age, gender, and desired employment within or outside the USA were also documented. An employability scale was created from the initial employment questions. Subjects were separated into four employability groups based on their employability score: poorly employable, marginally employable, satisfactorily employable, and optimally employable. An ANOVA test was performed on each quality using the four employability groups; a p-value less than 0.05 was considered significant. **Results:** 3,930 surveys were distributed; 884 certificants (22.5%) returned completed surveys. Six of the 10 qualities evaluated were significantly associated with employability: overall education ($p<0.01$), number of clinic hours ($p<0.01$), grade-point average ($p<0.01$), number of schools in a 100-mile radius ($p<0.01$),number of board attempts ($p<0.01$), and number of clinics ($p=0.04$). The qualities that were not statistically significant were age, gender, employment location sought, board score, single vs. dual certification, program level of education, and number of graduates in the class. **Conclusion:** There are multiple graduate and program qualities which are predictive of employability of NMT graduates.

Keywords: employability, nuclear medicine technology programs, initial employment

Introduction

Both the students and faculty of nuclear medicine technology (NMT) programs want to know what they can do to ensure success upon graduation. One measure of success is the employability of the program's graduates. For student recruitment and continuing accreditation purposes, program directors must assist students in employment placement (*1*).

There are numerous student and program qualities that may be predictive of employability. One such quality that has received much attention is level of education. In 2005, The Society of Nuclear Medicine and Molecular Imaging-Technologists Section (SNMMI-TS) recommended that the entry-level education into the field be at the baccalaureate degree, effective in 2015 (*2*). But as of 2012, only 46-60% of NMTs held baccalaureate or more advanced degrees (*3, 4*). The benefit of obtaining a higher degree has not been evaluated in terms of employability.

Grade point average (GPA) is used by many programs as an admission criterion. While a study in 2009 compared admission criteria (including GPA) and student success for medical radiation sciences programs (*5*), they did not evaluate the use of GPA for the employability of students after graduation, either before or during NMT training.

Other qualities may be program-specific; as NMT programs do not have standardized programs of study, there is much variation in the level of education required at admission, class size, number of clinical hours, and the number of clinical sites (*6*). In a 2016 study comparing the number of clinical sites and job placement rates, no relationship between them was seen (*1*), but

the other qualities have not been studied. Another issue is single- vs. dual-certification. In 2008, the SNMMI-TS added CT to the recommended curriculum for educational programs (*7*). As programs add CT to the curriculum, employability of dual-certified graduates needs to be evaluated.

Another metric that may be compared with employability is passing the entry-level exam on the first attempt. Until 2017, the NMT certification board (NMTCB) utilized three passing levels (pass, pass with distinction, and pass with highest distinction) for their entry-level exam. To our knowledge, no one has looked at employability based on passing the entry-level exam on the first attempt, or distinction level.

Age and gender are two qualities that cannot be controlled. In 2013, the NMTCB conducted a salary survey, which showed slightly higher salaries for males and with increasing age (*8*). However, the authors did not compare employability by gender. In terms of age, the survey did reveal that salary increases as years of experience increases. It also showed that salary increased as the age of the respondent increased (*8*). However, it did not look at age independent of years of experience.

The job market for new NMTs has been depressed for several years. Understanding the impact of different qualities on employability will allow program directors to focus on key areas to help students successfully find employment. Students and program leaders may be able to affect the qualities needed to graduate with higher employability success. But these qualities that lead to

optimal employability have not been systematically evaluated. The purpose of this study was to determine the association between employability and qualities of NMT graduates and programs.

Materials and Methods

Institutional Review Board approval was sought and this study was determined to have exempt status. The study complied with the Health Insurance Portability and Accountability Act guidelines.

An email list was obtained from the NMTCB including everyone (n=3,930) who passed the entry-level NMT exam between January 2012 and December 2016. We developed a survey using REDCap™ online software. The survey included questions about demographics, NMT program qualities, NMT graduate qualities, and initial employment obtained in the NMT field (Fig. 1). Demographic data included gender, age, and whether initial employment was sought within or outside the United States. Qualities for NMT programs included program level of education, number of graduates in the class, number of clinical sites rotated through, number of clinical clock hours done while in the NMT program, and number of NMT programs within a 100-mile radius of their program. Qualities for NMT graduates included highest level of education, grade point average, number of board attempts taken, board score (pass, pass with distinction or pass with highest distinction) and single vs. dual certification. Employment questions included time from graduation to initial employment, type of NMT position (full-time, part-time, per diem), proximity of employment to desired location, and proximity of employment to school program. For each question, a quantitative score was given.

For education (both overall and program level), a score of 1 was given for a certificate, 2 was given for an associate's degree, 3 was given for a baccalaureate degree, 4 was given for a master's degree and 5 was given for a doctoral degree. For number of clinical hours, a score of 1 was given for 0-250 hours, a score of 2 was given for 251-500 hours, a score of 3 was given for 501-750 hours, a scoe of 4 was given for 751-1000 hours, a score of 5 was given for 1001-1250 hours, a score of 6 was given for 1251-1500 hours and a score of 7 was given for greater than 1500 hours. For GPA, a score of 1 was given for 1.99 or below, a score of 2 was given for 2.00-2.49, a score of 3 was given for 2.50-2.99, a score of 4 was given for 3.00-3.49, a score of 5 was given for 3.50-3.99 and a score of 6 was given for 4.0 or greater. For results on NMTCB boards, a score of 1 was given for a pass result, a score of 2 was given for a pass with distinction result and a score of 3 was given for a pass with highest distinction result.

A 100-point employability scale was created using initial employment questions (Fig. 2). Subjects who did not complete the survey were sent an email reminder every five days for a total of 20 days. Data was collected and analyzed using RedCap™ software.

Statistical Tests

Subjects were divided into four employablility groups based on their employability score:

- Poorly employable = 0
- Marginally employable = 1-59
- Satisfactorily employable = 60-75
- Optimally employable > 75

Demographics, program qualities, and graduate qualities were compared among the four employability groups using an ANOVA test. A p-value of less than 0.05 represented statistical significance and revealed a difference in employability based on that quality or demographic. A

correlation coefficient was also performed on all qualities and demographics when compared to employability. Descriptive statistics were performed on all four employability groups, as well as demographic data. For all program and graduate qualities that revealed statistical significance, a new scale corrected score was assigned (between 0 and 345). The qualities with positive correlations were added and the qualities with a negative correlation were subtracted. They were then divided into the four employability categories and an ANOVA test was done. A p-value of less than 0.05 represented statistical significance.

Results

Of the 3,930 surveys sent out from the NMTCB email list, 884 of the subjects completed the survey for a return rate of 22.5%. 593 of 884 subjects (67%) were female and 292 (33%) were male. The age distribution was as follows: 474 of 884 subjects (53.6%) were age 18-25, 254 (28.7%) were age 26-33. 97 (10.97%) were age 34-41, and 60 (6.79%) were age 41 years or older. 785 (88.8%) of the 884 respondents secured employment as a NMT. The number in each employability group is given in Table 1.

There were 84 subjects who sought NMT employment outside the United States. 79 of the 84 (94.05%) subjects gained employment in NMT outside the United States. There were 800 subjects who sought employment within the United States. 707 of the 800 (88.38%) subjects gained employment within the United States.

There was no significant correlation between employability group and age, gender, or whether US employment was sought. The following six qualities were significantly associated with employability: overall education ($p<0.01$), number of clinical sites rotated through ($p=0.04$), number of clinical hours performed ($p<0.01$), grade point average ($p<0.01$), number of schools within a 100 mile radius ($p<0.01$), and number of board attempts ($p<0.01$). P-values and correlation coefficients are listed in Tables 2-4. Note that that was an inverse relationship between employability and number of board attempts and number of schools within a 100 mile radius.

The qualities that were not statistically significant were board score (level of distinction), single vs. dual certification, program level of education, and the number of graduates in the class. Descriptive Statistics were performed for the six qualities that had p-values below 0.05. Table 4 shows mean (standard deviation) for each quality broken down by employability category.

For overall education, the mean was highest for the poorly employable and optimally employable categories. For number of clinical sites, the mean number increased as employability increased. For number of clinical hours, the top three employability categories yielded mean scores close to 5 (1001 to 1250 clock hours). The poorly employable category yielded a mean score closer to 4 (751-1000 clock hours). For GPA, the mean score increased as employability increased. For number of schools in a 100-mile radius, the highest mean number appeared in the poorly employable category and the lowest mean appeared in the optimally employable category. For number of board attempts, the highest mean appeared in the poorly employable category (Figure 3).

The six qualities that yielded a p-value less than 0.05 (Table 5) were evaluated together. The qualities were scale corrected, between 0 and 345. Those with a positive correlation were summed and those with a negative correlation were subtracted and a new overall score was created for these six categories (Table 6).

This new score was separated using the same employability score and an ANOVA test was run. The p-value for those six qualities was 0.000000479. Figure 4 shows a box plot for the six qualities with a p-value below 0.05.

There was a weak but not statistically significant decrease in employability with age (correlation -0.07) (Figure 5).

While there was no statistical significance in employability with regards to gender, there was a small positive correlation for gender (0.05). Males had a higher percentage in the poorly employable category, while females had a higher percentage in the satisfactorily and optimally employable categories (Figure 6).

While there was no statistical significance in employability with regards to employment sought within the USA vs. elsewhere, there was a small negative correlation (-0.05). The percent of those who sought employment outside the United States was higher for the satisfactorily employable category and optimally employable category and lower for the poorly employable category and marginally employable category (Figure 7).

Discussion

Our study has shown that there are multiple, often controllable factors that affect employability of NMT program graduates. These include overall education of the admitted students, the number of clinical sites rotated through, the number of clinical hours performed, the grade point average of admitted students, the number of schools within a 100 mile radius, and the number of board attempts. Other factors sometimes thought to be predictors of employment success were not found to be so. These include age, gender, program level of education (certificate, associate, or baccalaureate degree), single- vs. dual-certification, and class size.

NMT program directors may be able to increase the employability of their graduates if they adapt their programs to offering at least 1000 clinical hours. For administrators considering the development of new NMT programs, they should consider the availability of other programs within a 100-mile radius, as multiple programs close in proximity tend to decrease employability of their graduates. Programs that offer students multiple experiences in different clinical sites also leads to an increase in employability.

NMT students may be able to increase their employability with increased education. While the level of education of their program is not statistically significant, their overall education is. The higher the education, the more employable they are. Students should also focus on their grade point average. The higher their GPA, the more employable they are. They should also strive to pass the entry-level exam on their first attempt. Knowledge by potential employers that the student required more than one attempt to pass the exam appears to affect their willingness to

hire that student. Students should not focus on the score they receive on the board exam as there was no statistical significance between those who passed, passed with distinction or passed with highest distinction.

Education level in the NMT program was not found to be predictive of employability. Yet there have been multiple recent surveys on this topic with widely varying results. In 2012, the Nuclear Medicine Technology Certification Board (NMTCB) surveyed 21,383 active certificants. The overall educational breakdown in that survey was that 9.2% held a certificate or diploma, 20.08% held an associate's degree, 48.67% held a baccalaureate degree, 9.41% held a master's degree and just less than 1% held a doctoral or post-doctoral degree (*3*). The American Society of Radiologic Technologists (ASRT) conducted an enrollment survey in 2016. The ASRT enrollment snapshot also found that most program's level of education is an Associate's degree (*4*). While there has been a push by some stakeholders to increase the entry level education of NMTs to the baccalaureate degree, this study found that it is the overall education of the NMT, not the program level education, that lead to a higher degree of employability.

Single- vs. dual-certification did not affect employability in this study. This finding was seen despite a push within the NMT educational community to emphasize training in CT. On August 4, 2007, a CT consensus conference occurred with stakeholders to discuss who would be doing CT. A consensus statement was established which stated, "CT has become a core skill for nuclear medicine technologists when using hybrid technology" (*9*). In 2007, the SNMMI-TS added performance of CT scans and the administration of contrast for these scans to the scope of

practice for NMTs. However, this study did not reveal that dual certification lead to a greater degree of employability, at least for initial employment.

We found that neither age itself nor gender affected employability. A recent survey of age and gender differences focused on income (*8*). It revealed that 57% were female and 43% were male. Males had a mean salary of $76,536 (median $74,000) and females had a mean salary of $72,207 (median $69,500). The survey did not compare employability by gender. In terms of age, the survey did reveal that salary increases as years of experience increases. It also showed that salary increased as the age of the respondent increased. However, it did not look at age independent of years of experience.

A limitation of this study was that only those who took the NMTCB entry-level exam were included. The American Registry of Radiologic Technologists entry-level nuclear medicine technology exam was not used. In addition, the state of the job market during the years that the subjects graduated was depressed. Future research that could control these limitations would be valuable.

Conclusion

Multiple factors are associated with employability. For NMT graduates, these include overall education, grade point average, and number of board attempts. For NMT programs, these include number of clinical sites rotated through, number of clinical hours performed, and number of schools within a 100 mile radius. Age, gender, program level of education (certificate,

associate, or baccalaureate degree), single- vs. dual-certification, and class size did not predict employability.

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Demographic Questions

1. Are you a graduate employed outside the United States?
2. What is your gender?
3. What was your age at the time of completion from the Nuclear Medicine Technology Program?

Program Quality Questions

1. What was the level of education for your nuclear medicine technology program?
2. How many Nuclear Medicine Technology students were in your graduating class (including yourself)?
3. How many different clinical sites did you rotate through?
4. How many clock hours of clinical experience did you receive during your program?
5. How many Nuclear Medicine Technology schools are within a 100-mile radius of your program?

Graduate Quality Questions

1. What is your highest level of education?
2. What was your GPA on a 4.0 scale?
3. How many times did you take the entry-level CNMT exam through the NMTCB?
4. What were the results of your NMTCB boards?
5. Did you have more than one certification at the time of initial employment?

Initial Employment Questions

1. When did you secure your initial employment as a Nuclear Medicine Technologist?
2. What kind of position was your initial employment?
3. What was the proximity of this initial employment to your desired location of employment?
4. How close was this initial employment to the location of your program school?

Figure 1: Questions related to demographics, program and graduate qualities, and initial employment.

Employability Scale

Time to Employment
30 points – prior to graduation
25 points - Within 1 Month Post-Graduation
20 points - 1 to Less than 3 Months Post-Graduation
15 points - 3 to Less than 6 Months Post-Graduation
10 points - 6 to Less than 12 Months Post-Graduation
5 points - 12 or More Months Post-Graduation
0 points - Did Not Secure Employment

Type of Position
30 points - Full Time Position
24 points - Full Time Hours
18 points - Part Time Position
12 points - Part Time Hours
6 points - PRN Position
0 points - Did Not Secure Employment

Proximity of Employment to Desired Location
25 points - 1-50 miles
15 points - 51-100 miles
5 points - more than 100 miles
0 points - Did Not Secure Employment

Proximity of Employment to School
15 points -1-25 miles
12 points - 26-50 miles
9 points - 51-150 miles
6 points - 151-300 miles
3 points - more than 300 miles
0 points – Did Not Secure Employment

Figure 2: Employability scale used to calculate individual subjects' employability scores.

Employability Score	Employability Category	Number (percent) of subjects
0	Poorly Employable	99 (11.2%)
1-59	Marginally Employable	264 (29.9%)
60-75	Satisfactorily Employable	297 (33.6%)
76+	Optimally Employable	224 (25.3%)

Table 1. Employability Scale, Category, and Number (percent) of Subjects

Demographics	P –value	Correlation coefficient
Age	0.123956	-0.07856
Gender	0.195393	0.048852
International	0.330178	-0.05477

Table 2: Subject demographics compared to employability

Graduate qualities	P –value	Correlation coefficient
Overall education	0.003107	0.034391
GPA	0.002007	0.118697
Number of board attempts	0.000427	-0.14134
Board score (distinction level)	0.204388	0.077608
Dual certification	0.354562	-0.00073

Table 3: Graduate Qualities Compared to Employability

Program qualities	P –value	Correlation coefficient
Program education	0.65737617	0.03465843
Number of graduates	0.692571	-0.0172
Number of clinics	0.039616	0.07667
Number of clinical hours	0.002089	0.070851
Number of schools in 100 mile radius	0.003685	-0.09676

Table 4: Program Qualities Compared to Employability

	Poorly employable	Marginally employable	Satisfactorily employable	Optimally employable
Overall Education (p<0.01)	2.8586 (0.6852)	2.6906 (0.5728)	2.7778 (0.5734)	2.875 (0.5542)
Number of clinics (p=0.04)	3.7677 (2.0841)	3.7547 (2.1205)	4.1010 (2.0251)	4.2857 (2.3214)
Number of clinical hours (p<0.01)	4.4040 (1.8677)	5.0334 (1.7153)	5.1313 (1.7202)	4.8036 (1.8085)
GPA (p<0.01)	4.5556 (0.7454)	4.6226 (0.7494)	4.7914 (0.6903)	4.7813 (0.6639)
Number of schools in 100 mile radius (p<0.01)	1.8788 (1.2958)	1.4302 (1.2747)	1.5017 (1.2140)	1.3393 (1.2169)
Number of board attempts (p<0.01)	1.1515 (0.4371)	1.0641 (0.2746)	1.0269 (0.1622)	1.0446 (0.2276)

Table 5 Mean (Standard Deviation) for qualities that yielded a p-value of less than 0.05.

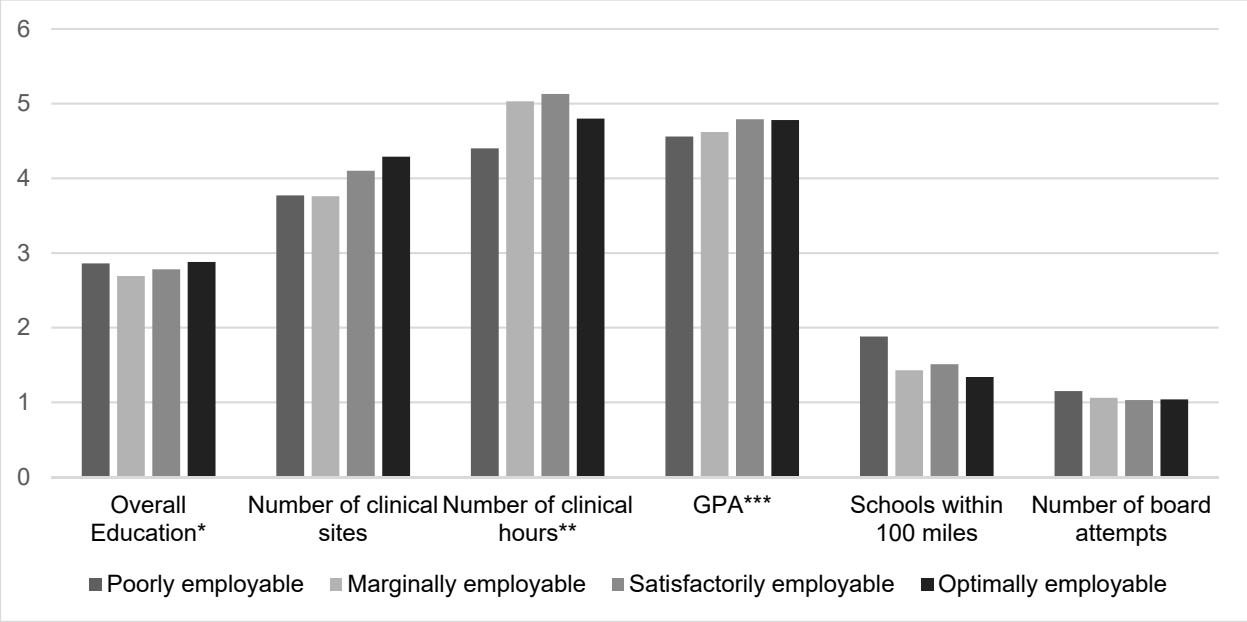

Figure 3 Qualities that Affect Employability

	Median	Mean	Standard Deviation
Poorly Employable (N = 99)	173	172.3838	58.5759
Marginally Employable (N = 264)	193	193.0717	55.2589
Averagely Employable (N = 297)	207	202.5118	51.8757
Optimally Employable (N = 224)	215	205.5291	57.1893

Table 6. Scale-corrected scores for the six factors significantly associated with employability

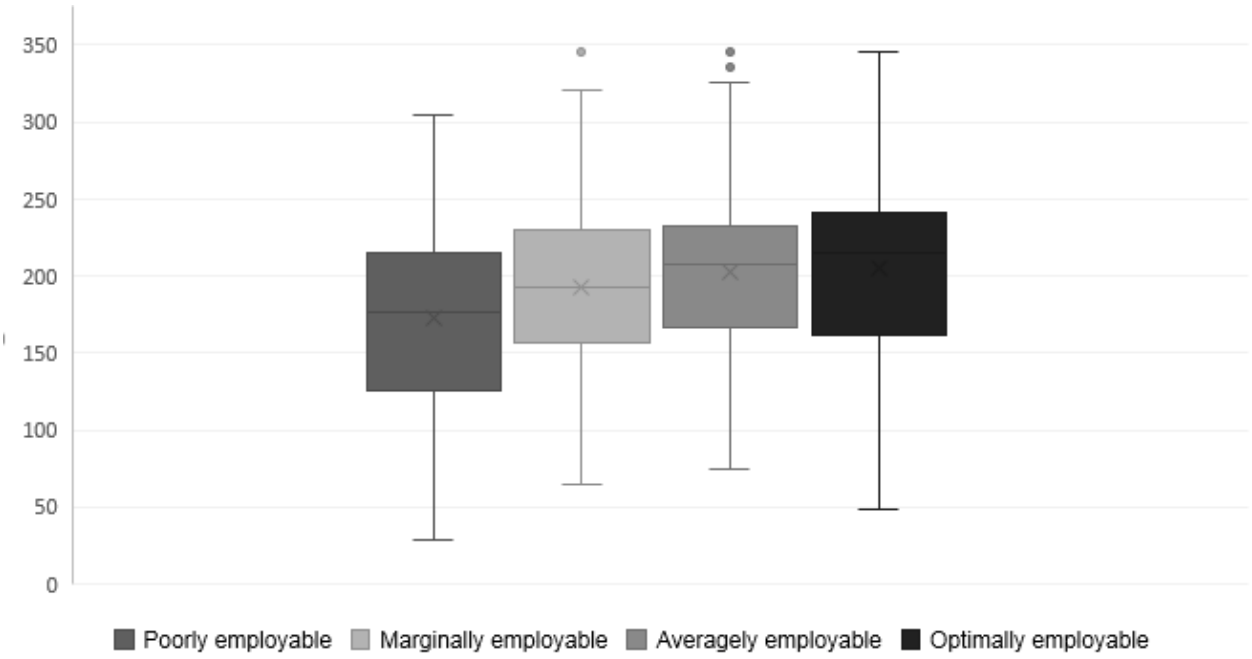

Figure 4. Box plot for the scale-corrected scores for the six factors significantly associated with employability

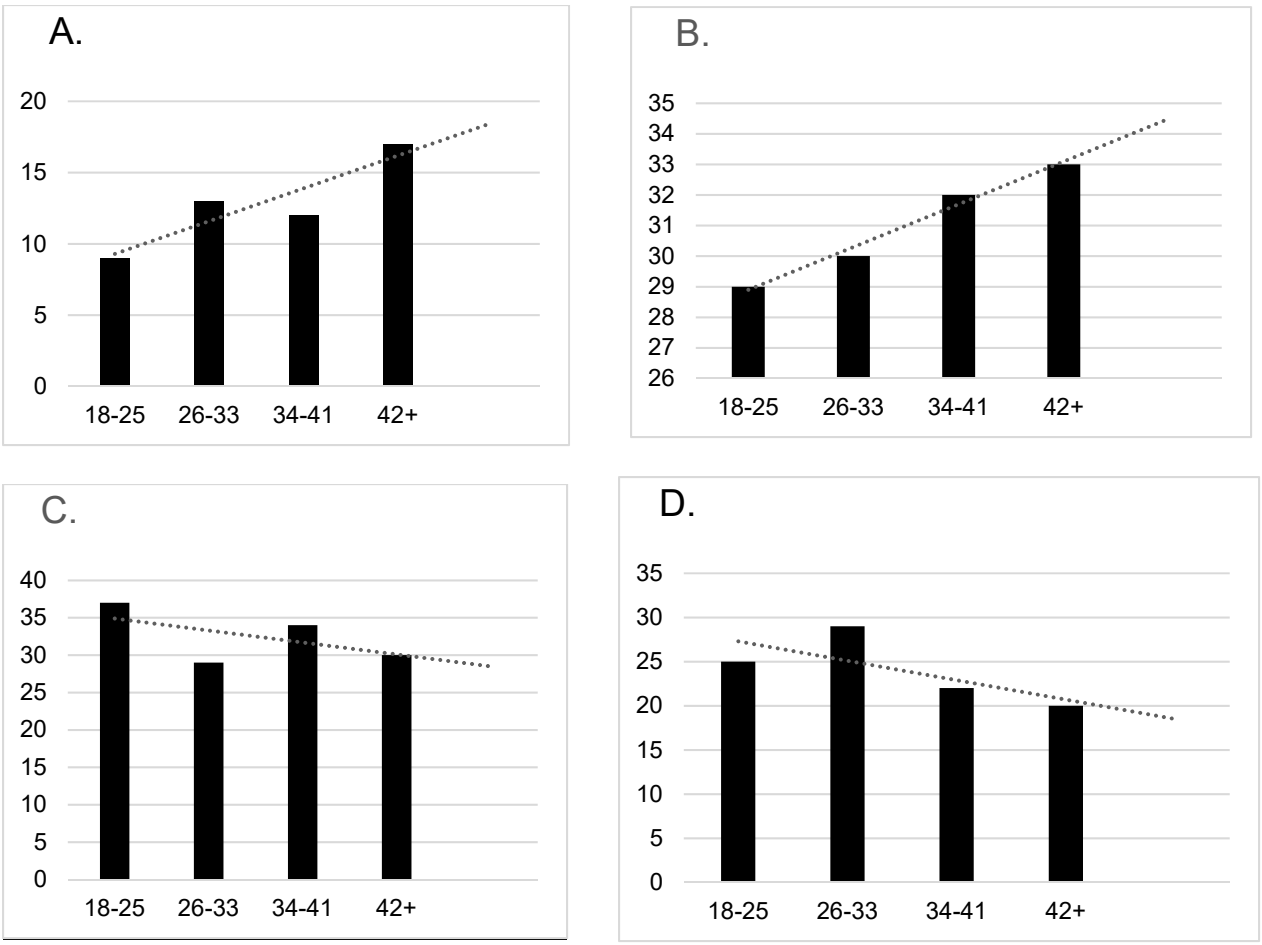

Figure 5. Percent employable by employability category and age, where age is on the X-axis and employability is on the Y-axis. A. Poorly employable, B. Marginally employable, C. Satisfactorily Employable, D. Optimally Employable

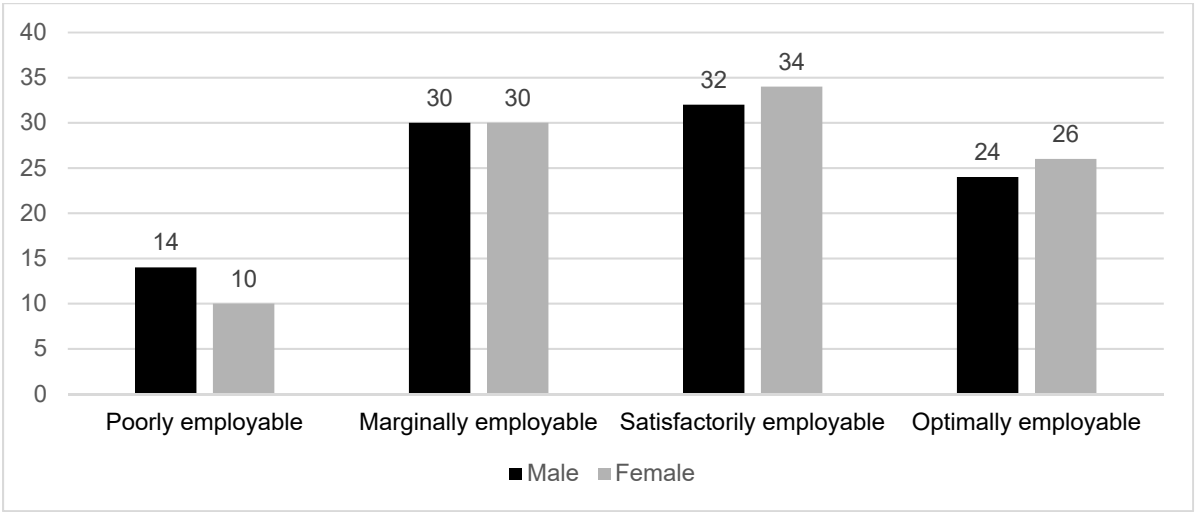

Figure 6. Percent of each employability category by gender.

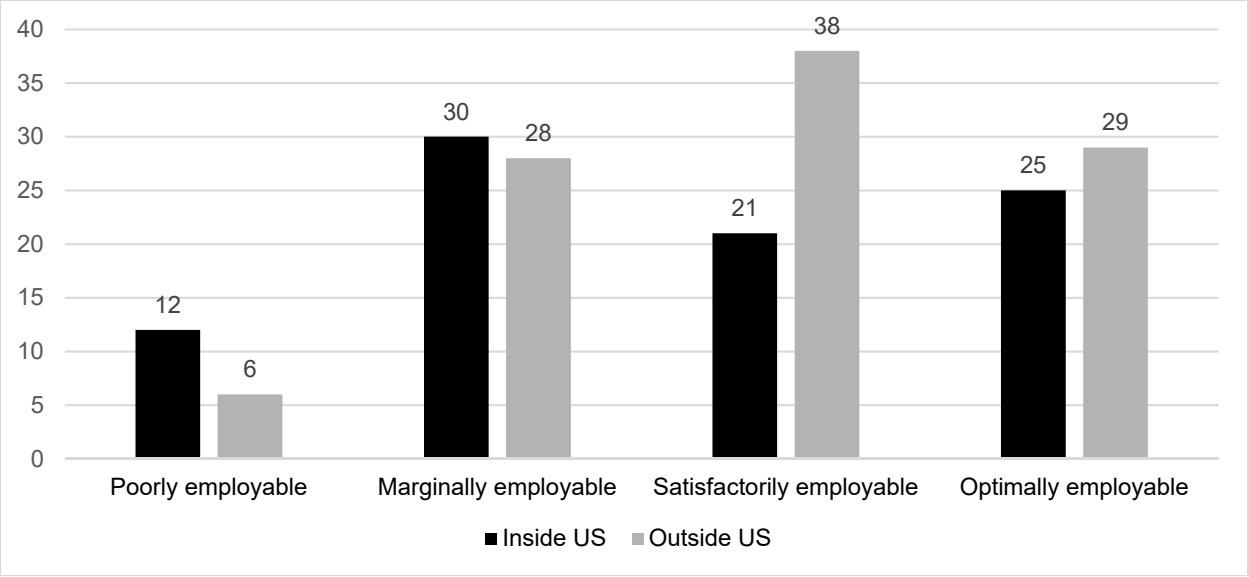

Figure 7. Percent employed inside and outside the United States by employability category.