Summer Research School inspires high school students to a career in research

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Abstract

On the 30th anniversary of the Karolinska Institutet Summer Research School for High School students an evaluation was carried out of the school's activities. The evaluation was performed by questionnaire sent to 533 former students and also by searching the KI course registration database for all former students who went on to register in under- or postgraduate education at KI. Approximately half of all former Summer School students performed their undergraduate studies at KI, predominantly in the medical program. Those were far more likely to choose a research-oriented education than their peers. KI Medical students who previously attended the Summer School were also more likely to later register for PhD education than their peers who did not attend the summer school.

Introduction

The Summer Research School with Biomedical Orientation for High School students (*Sommarforskarskolan med Biomedicinskt Inriktning för Gymnasieelever)* was established at Karolinska Institutet in 1985. The purpose of the Summer Research School has been to introduce young students to biomedical research at an early stage in their careers, and to inspire those students to pursue further studies in the biomedical sciences. Students who have completed either the second or third years of the three-year natural sciences program at Swedish high schools are eligible to apply. Each year between June and August, 20 students are accepted to the school and each will take an active part in research projects ongoing at the institute.

Many of the leading universities around the world organize summer courses for high school students, but only a few offer the possibility for young people to take an active part in ongoing research projects under the direction of established researchers. A significant such example is the "Rockefeller University Summer Science Research Program" [1], which is a summer course for high school students whose approach in many respects reminiscent of the Summer Research School at KI.

In connection with the KI Summer Research School's 30th anniversary in the Spring of 2015, an evaluation was conducted to find out if, and if so to what extent, the School has fulfilled its goal of inspiring young people to continue studies in biomedical research. This short report is intended as a description of the procedures employed for that evaluation and a presentation of selected results and conclusions. The full data set is available upon request. The evaluation consisted of two parts; a questionnaire addressed to all former participants in the Summer Research School in the years 1985-2014 (n = 533), and an analysis of the Karolinska Institutet's educational register (*lokalt ADB-baserat studiedokumentationssystem*, 'LADOK'), where educational information about students registered at the Karolinska Institutet is available. We believe that the combination of these two methods gives us the best possible appreciation of the Summer Research School participants' continued choice of study.

Methods

Questionnaire. Addresses of 533 Summer Research School alumni were sourced from the Swedish tax authority (*Skatteverket*). Anonymous questionnaires (in Swedish, see supplementary information) together with stamped and addressed return envelopes were sent by regular mail. Recipients were asked to complete the questionnaire and return it to the authors within a 2-month period. Participation was voluntary, no names or identifying details were requested.

Database search. Data on all course registrations by Summer Research School alumni back to 1985 was retrieved from the database by LADOK administrators. Information requested included; to which undergraduate education programmes did the student register and in which year did they complete; if the students had registered to free-standing research preparatory courses and if and when did the students register and graduate from research education. An age-matched control group was generated using the Random function in Microsoft Excel from a list of all KI medical students during 1985-2008.

Results

In total, 182 questionnaires were returned, representing 34,8% of all alumni for whom we could find addresses (121 female, 53 male and 8 did not specify). 10 were returned marked 'not known at this address'. Geographically, 67 had attended high school in Stockholm, 51 in Götaland, 31 in Svealand and 9 in Norrland. Answers were received from at least one student from every year of the school except 1986.

Without exception, 100 % of evaluation respondents have progressed to undergraduate education of some form. During application for undergraduate education, KI had been first choice for 55% of them. Of those that specified, 67% had studied medicine, 16% studied engineering, 12% studied natural science and the remainder studied different subjects (Figure 1A). 42% of respondents had taken their undergraduate education at KI. Of 117 respondents that had studied medicine at any university, 35% had specifically chosen a research-directed education.

With regard to further research training, 56 of the respondents (30.1%) had successfully defended a PhD, of which 30 had done this at KI, 24 at other universities in Sweden and 2 abroad (Figure 1B). An additional 8 respondents had registered as in doctoral education but had not yet completed their doctoral degree. 24 respondents (13.2%) had started or completed research at postdoctoral level, and 17 had continued to obtain an Associate Professorship or higher rank within academia.

The questionnaire also included some questions with the aim to register respondent's own opinions on the Summer Research School. Answers to questions such as 'Has the Summer Research School stimulated your interest in research?' and 'Did the Summer Research School influence your choice of education?' were overwhelmingly positive (Figures 1C-D). Notably, the question 'Do you think KI should continue to organise a Summer Research School?' received 97% positive answers (not shown).

Our investigation of the database LADOK showed that 242 of those who had participated in the Summer Research School between the years 1985 to 2014 had registered for undergraduate education at KI. This represents 44.7% of all summer students from those years and is in good agreement with the 42 % reported by questionnaire respondents. Of these, 154 (63.6%) were female and 88 (36.4%) were male. The majority of Summer Research School participants who had enrolled in a basic education at KI did so in the medical program (n = 201, corresponding to 83%), but other programs such as Biomedicine (n = 33) and the Dentistry program (n = 13) were also represented (Figure 2A).

Of the participants who attended the Summer Research School during the period 1985-2008, 87 of the 438 (19.9%) had registered in a PhD program at KI. Of these, 55 (63.2%) were female and 32 (36.8%) were male. Of the 378 who had taken the Summer Research School between 1985 to 2005, 60 (15.9%) had completed a PhD at KI (data not shown). When we specifically examined the Summer School alumni that had studied at the Medicine program at KI between 1985-2008 (Figure 2B), it was found that 38.6% later continued in doctoral education at KI. By comparison, only 14.0% of an age-matched control group consisting of medical students at KI who had not attended the Summer Research School had later registered as doctoral students. This indicates that participation in the Summer Research School correlates with an increased

tendency to later apply for postgraduate education among the students who have chosen to study the medical program at KI and suggests that the Summer School has generally succeeded in its main aim to inspire medical students to research.

In another initiative to stimulate medical students for increased research engagement, a medical program with research focus at KI (*Läkarutbildning med Forskningsinriktning*, LäFo) was started in 1986. In 2010, this was replaced by a research introductory course (*Forskningsintroducerande kurs på Läkarutbildningen*, FoLäk) that could be read in parallel with the regular medical program. Courses and efforts with similar aims have also been provided at the medical programs in Gothenburg, Linköping, Umeå and Uppsala. However, the proportion of medical students undergoing postgraduate education has decreased in recent decades and research indicate a shortage of medical practitioners in research [2, 3]. It is therefore of interest that as many as 34.2% of those who answered in the questionnaire answered that they had started or completed a medical program in Sweden stated that they had also chosen to take LÄFO/FoLäk or a research introductory course in parallel with the medical program. In view of the fact that research introductory courses are not offered at all of Sweden's medical schools and have not been available during the entire period under study, this figure can be considered to be particularly high. Data from LADOK show that the 201 participants who had been admitted to a medical program at KI during the years 1985-2014, 94 persons (46.8%) had registered at either LÄFO or Foläk courses. By comparison, the annual intake of medical students to LÄFO or Foläk equals less than 10%. It is therefore reasonable to assume that the Summer Research School has had an impact on these students.

Discussion

That an early introduction to research can encourage research work later in the career has been shown in several previous studies. An evaluation of medical students at the University of Gothenburg showed that those who had come in contact with research early in medical education reported a greater long-term research interest than those that became involved with research later in their education [2]. In addition to an increased research interest, an early commitment to research has also been shown to

contribute to the development of students' technical abilities, as well as their capacity for independent and analytical thinking (for an overview, see [4, 5]). A study conducted at the University of California at San Francisco similarly showed that future success in graduate education correlates strongly with early work experience in research laboratories [6]. Mostly these articles focused on undergraduate degree projects. In comparison, few studies have been performed to determine if research activity at even earlier stages, such as high school age students can also lead to similar benefits. We view this evaluation as an opportunity, not just to determine the effects of Summer School on the KI intake, but also of early research exposure in general.

An important aspect of the context is also to look at how the tendency to continue further research studies differs between the genders. In a survey that investigated research interest of medical students at the University of Gothenburg, the female medical students reported generally less research interest than men [2]. Although we did not quantify the research interest of the students here, we observed no significant differences between numbers of female and male Summer Research School alumni who later continued into postgraduate education.

Conclusions

In conclusion, we show that the students who complete the Summer Research School apply for a postgraduate education to a very large extent. It is important to emphasize that those applying to the Summer Research School are often high-performing students who may already have an established interest in medical science, despite their young age. It is therefore is difficult to quantify how much of an influence Summer Research School has had on their career choices. However, our findings indicate that the Summer Research School has at the very least played an important role in maintaining and strengthening the research interest of the participants, to the extent that 38.6% of those who have subsequently chosen to read KI's medical program later enrolled in PhD education. Thus, we wish to emphasize that early involvement in research through projects such as the Summer Research School likely plays a positive role in stimulating future research activity in both upper secondary school and future doctors.

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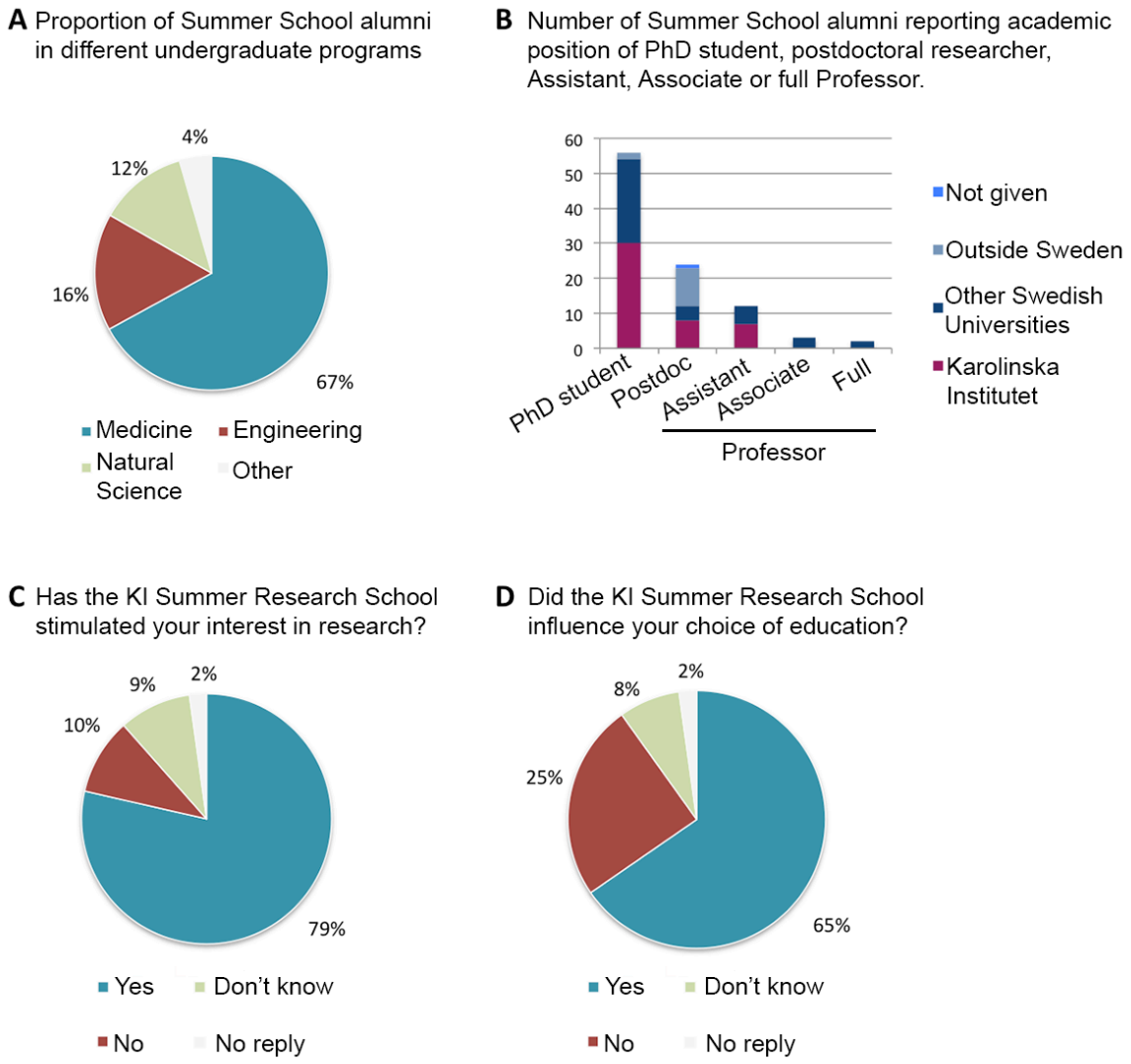

Figure 1: Results from the questionnaire survey

A. Proportions of Summer School Alumni in undergraduate education programs.

B. Number and geographical distribution of Summer School Alumni reporting academic positions. **C.** and **D.** Responses to indicated questions.

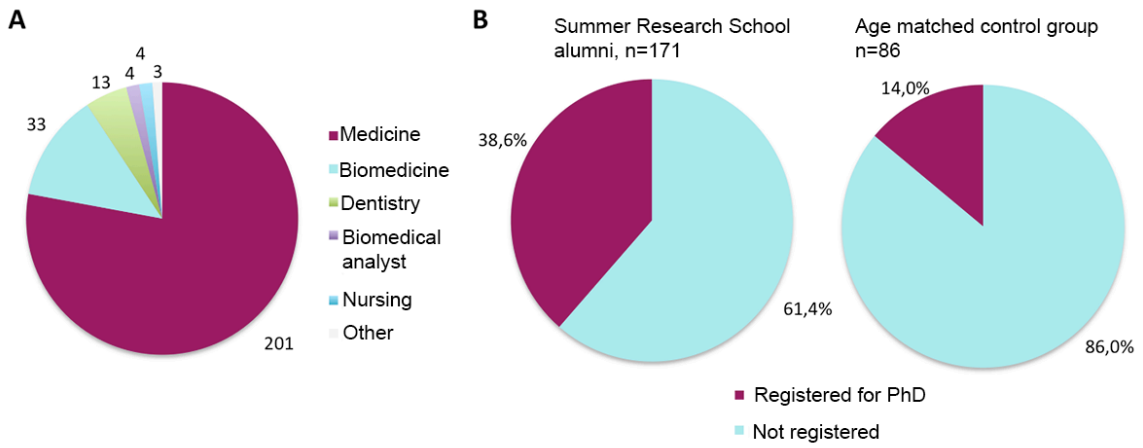

Figure 2: Results from the LADOK survey

A. The distribution of former Summer Research School participants registered in LADOK at KI's various undergraduate programs, the figures indicate the number of students. **B.** Percentage of medical students at KI between 1985-2008 registered at KI's doctoral program. Left side, medical students at KI who attended Summer Research School between 1985-2008. Right side, control group of age-matched medical students registered for KI's medical program between 1985-2008.

Supplementary Information: Evaluation Questionnaire

UTVÄRDERING AV KAROLINSKA INSTITUTETS SOMMARFORSKARSKOLA MED BIOMEDICINSK INRIKTNING (1985-2015)

I och med att Sommarforskarskolan med Biomedicinsk inriktning har anordnats på Karolinska Insitutet under 30 års tid, önskar vi nu utvärdera denna verksamhet. Vi är framförallt intresserade av vilken inverkan Sommarforskarskolan har haft på ditt intresse för forskning och vi hoppas även få en bild av hur du sedan har fortsatt dina studier och yrkesliv.

Besvara frågorna antingen med ett kryss (X) eller skriv ditt svar på det utrymme som ges. Om du vill avstå från att besvara vissa frågor eller om vissa frågor inte är relevanta för din del hoppar du bara över dessa. Om du exempelvis har påbörjat en utbildning men ännu inte tagit ut din examen besvarar du endast de delfrågor som är relevanta i ditt fall.

UTBILDNING

1. Vilken akademisk utbildning har du genomfört/påbörjat idag? *('Grundutbildning')*

Universitet/högskola: fristående kurs/enstaka kurs ☐ A AFS

år: .....

vid vilket universitet: .....

ämne: .....

Universitet/högskola: grundutbildning ☐ A AFS

år: .....

vid vilket universitet: .....

ämne: .....

Om du har svarat ”läkarutbildning” på ovanstående fråga, gick/går du på en läkarutbildning med forskningsinrikting?

☐ ja ☐ nej

Beskriv gärna

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2. Har du uppnått någon av följande: *(’Högre utbildning’)*

Licentiatexamen, ☐

år: .....

vid vilket universitet: .....

ämne: .....

PhD, ☐

år: .....

vid vilket universitet: .....

ämne: .....

Postdoc, ☐

år: .....

vid vilket universitet: .....

ämne: .....

Docent, ☐

år: .....

vid vilket universitet: .....

ämne: .....

Lektor, ☐

år: .....

vid vilket universitet: .....

ämne: .....

Professor, ☐

år: .....

vid vilket universitet: .....

ämne: .....

3. KI var mitt förstahandsval vid val av universitet:

ja ☐ nej ☐ vet ej ☐

motivera gärna ditt svar:

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4. Beskriv en prestation under din karriär som du är särskilt stolt över:

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SOMMARFORSKARSKOLAN

5. Vilket år gick du sommarforskarskolan vid KI: .....

6. Beskriv en positiv erfarenhet som du har tagit med dig från Sommarforskarskolan:

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7. Beskriv något som du upplevde som negativt med Sommarforskarskolan:

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8. Påverkade sommarforskarskolan ditt val av eventuell fortsatt utbildning?

ja AFS nej AFS vet ej AFS

motivera gärna ditt svar:

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9. Har KI:s sommarforskarskola stimulerat ditt intresse för forskning?

ja AFS nej AFS vet ej AFS

motivera gärna ditt svar:

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10. Anser du att KI bör fortsätta att anordna en sommarforskarskola för gymnasieelever?

ja AFS nej AFS vet ej AFS

motivera gärna ditt svar:

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11. Ev. övriga synpunkter och kommentarer om Sommarforskarskolan:

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BAKGRUNDSDATA

12. Man ☐ Kvinna ☐

13. Födelseår: .....

14. Vilken utbildning har dina föräldrar:

(*sätt kryss framför den/de utbildning/ar som dina föräldrar har*)

Grundskola eller motsvarande	☐ mamma	☐ pappa
Gymnasieutbildning	☐ mamma	☐ pappa
Universitet/högskola	☐ mamma	☐ pappa
Vet ej	☐ mamma	☐ pappa

15. I vilket land och i vilken ort fick du din gymnasieutbildning:

.....

Tack för din medverkan.

Enkäten skickas snarast tillbaka i bifogat svarskuvert. Sista svarsdag 1 maj.